

FIGURE 1 - General Overview of Distributed File Storage System

communication
with other server
nodes

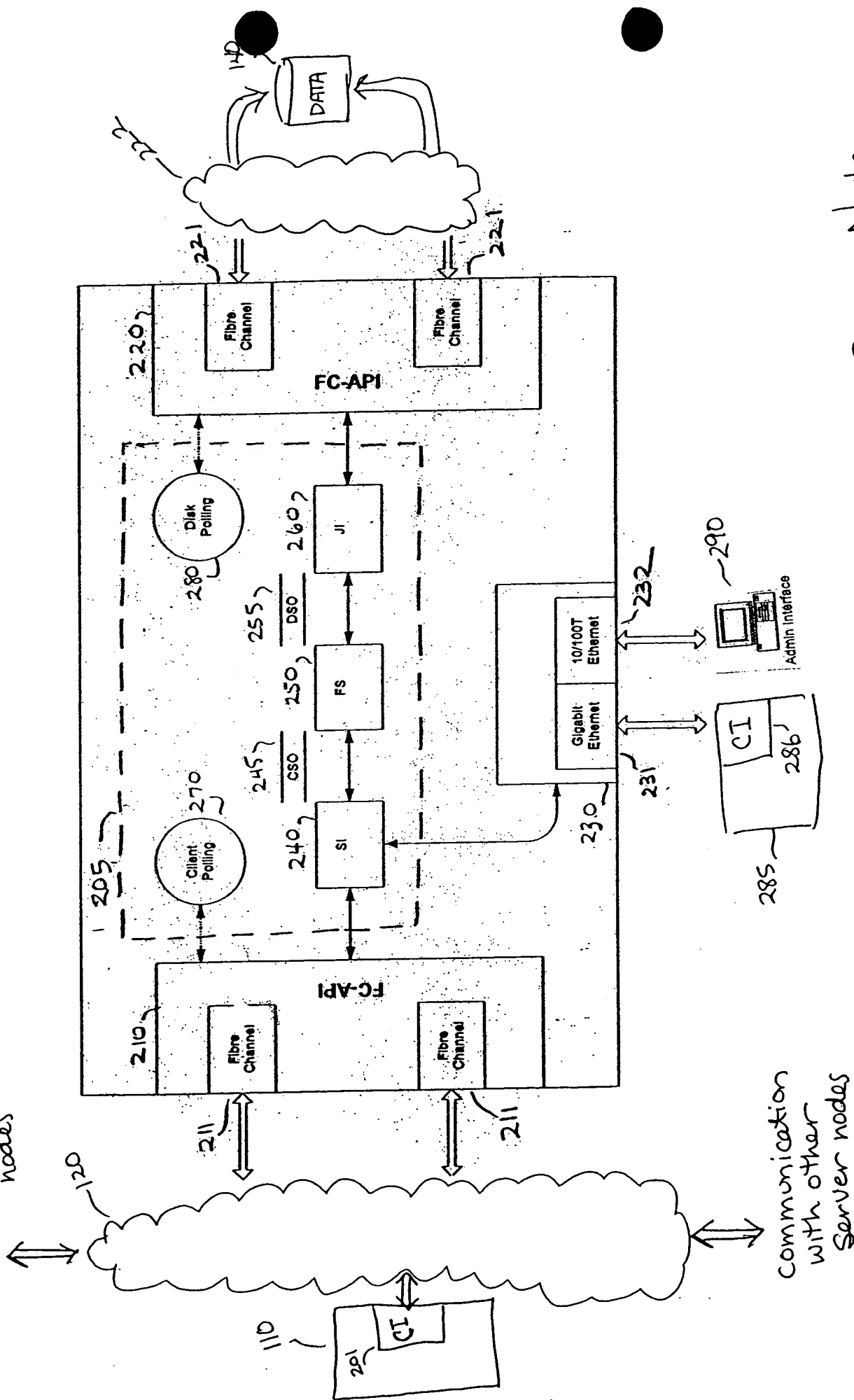


FIGURE 2: One Embodiment of a Server Node

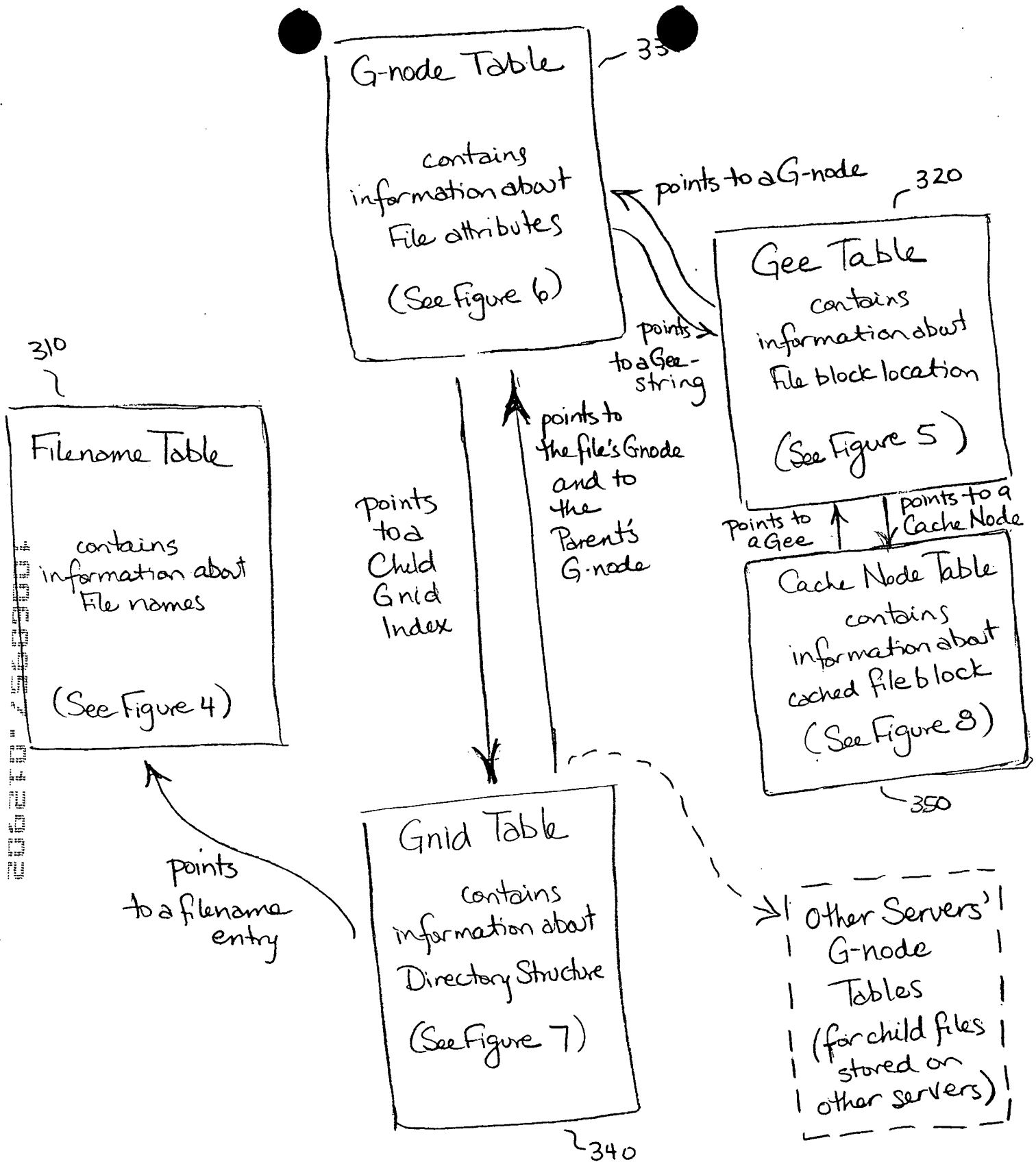


FIGURE 3 - Five metadata structures

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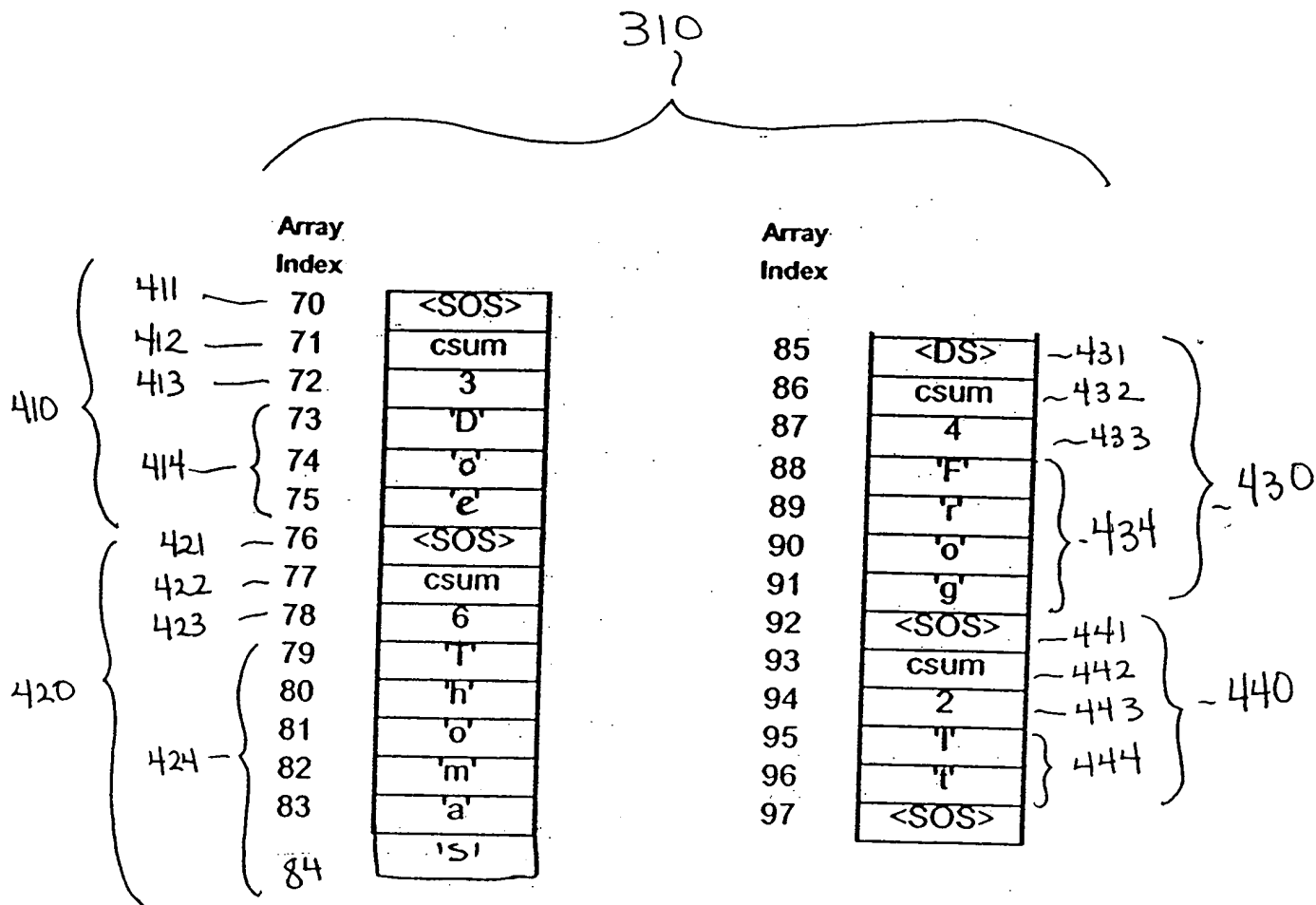


FIGURE 4- Sample Portion of a Filename Table

320

	Index	G-Code	Data	File Logical Block
S10-	45	GNODE	Gnode = 67, Extent = 2, Root = TRUE	
S11-	46	DATA	Disk Logical Blocks: 456, 457 Drive 13	1
S12-	47	DATA	Disk Logical Blocks: 667, 668 Drive 15	2
S13-	48	DATA	Disk Logical Blocks: 112, 113 Drive 19	3
S14-	49	PARITY	Disk Logical Blocks: 554, 555 Drive 2	
S15-	50	DATA	Disk Logical Blocks: 458, 459 Drive 13	4
S16-	51	DATA	Disk Logical Blocks: 669, 670 Drive 15	5
S17-	52	DATA	Disk Logical Blocks: 119, 120 Drive 19	6
S18-	53	PARITY	Disk Logical Blocks: 556, 557 Drive 2	
S19-	54	LINK	Index 76	
	
S20-	76	GNODE	Gnode = 67, Extent = 3, Root = FALSE	
S21-	77	DATA	Disk Logical Blocks: 460, 461, 462 Drive 13	7
S22-	78	DATA	Disk Logical Blocks: 671, 672, 673 Drive 15	8
S23-	79	PARITY	Disk Logical Blocks: 121, 122, 123 Drive 19	
S24-	80	LINK	Index 88	
	
S25-	88	GNODE	Gnode = 67, Extent = 3, Root = FALSE	
S26-	89	DATA	Disk Logical Blocks: 463, 464, 465 Drive 13	9
S27-	90	DATA	Disk Logical Blocks: 674, 675, 676 Drive 15	10
S28-	91	PARITY	Disk Logical Blocks: 124, 125, 126 Drive 19	
S29-	92	GNODE	Gnode = 43, Extent = 4, Root = FALSE	
	

FIGURE 5 - Sample Portion of a Gee Table

Attribute Data	
602	File Attribute - type
604	File Attribute - mode
606	File Attribute - links
608	File Attribute - uid
610	File Attribute - gid
612	File Attribute - size
614	File Attribute - used
620	File Attribute - fileId
622	File Attribute - atime
624	File Attribute - mtime
626	File Attribute - ctime
628	Child Gnid Index
630	Gee Index - Last Used
631	Gee Offset - Last Used
632	Gee Index - Midpoint
633	Gee Offset - Midpoint
634	Gee Index - Tail
635	Gee Offset - Tail
636	Gee Index - Root
638	Gnode Status
640	Quick Shot Status
642	Quick Shot Link

600

FIGURE 6 - G-NODE ATTRIBUTES

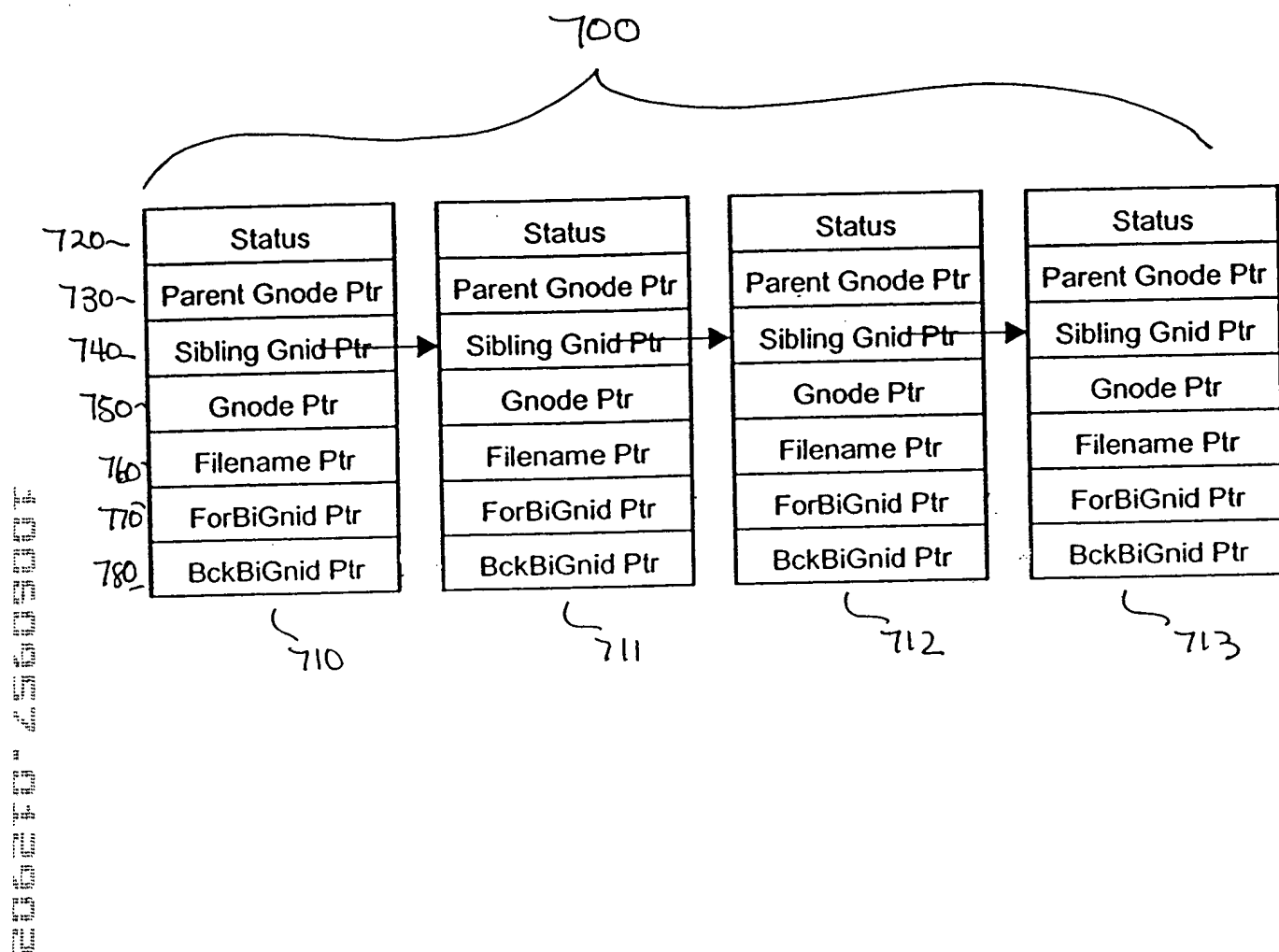


FIGURE 7- Structure of a Gnid String

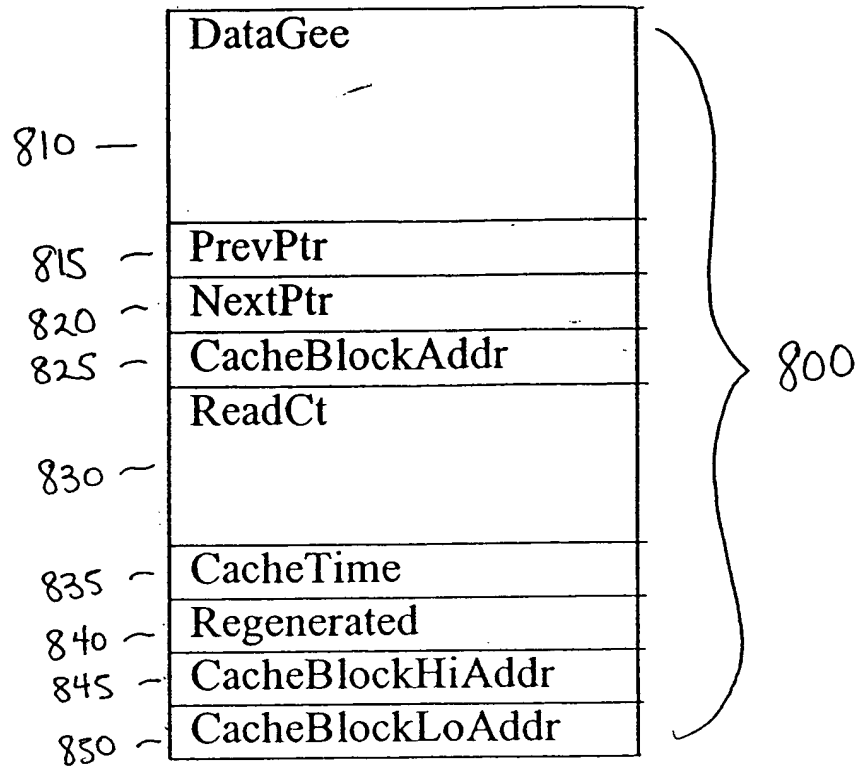


FIGURE 8a - Structure of a Cache Node

350

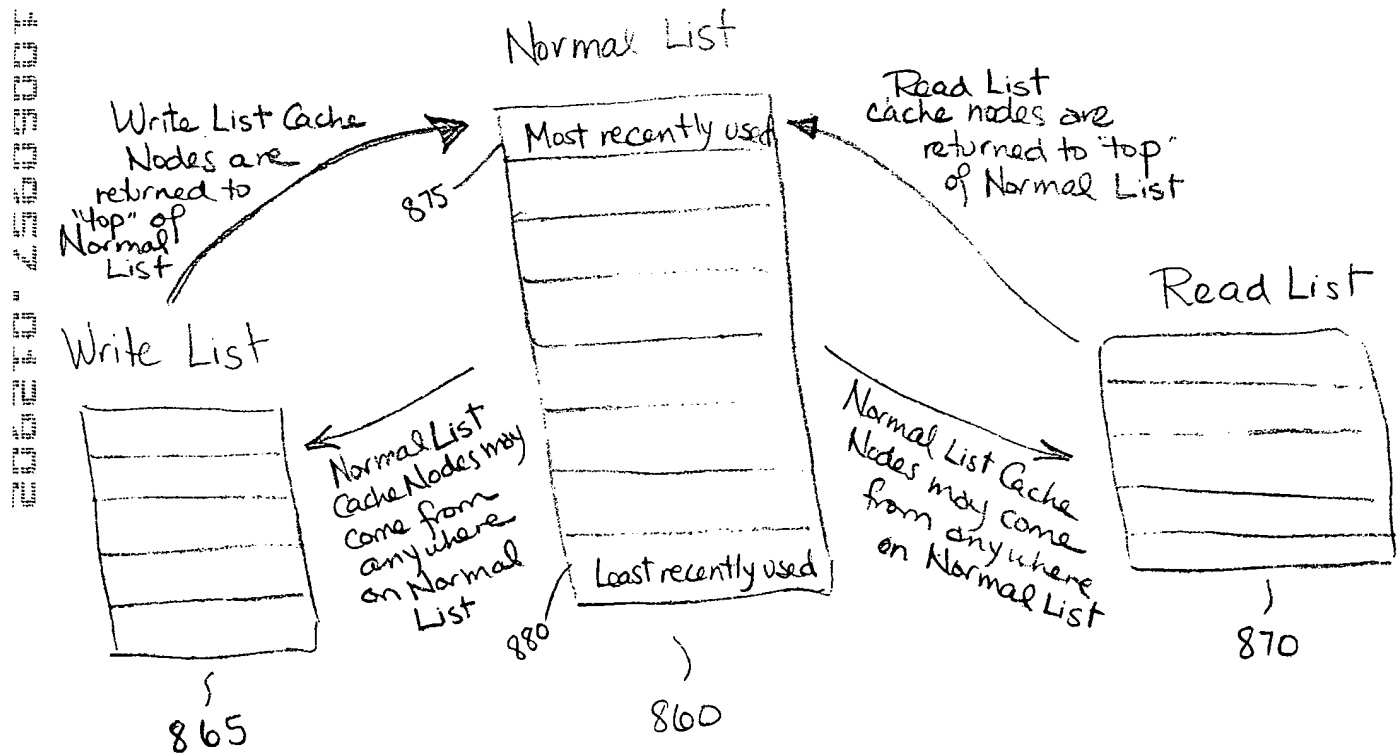


FIGURE 8B - Conceptual division of a Cache Node Table into Three Lists

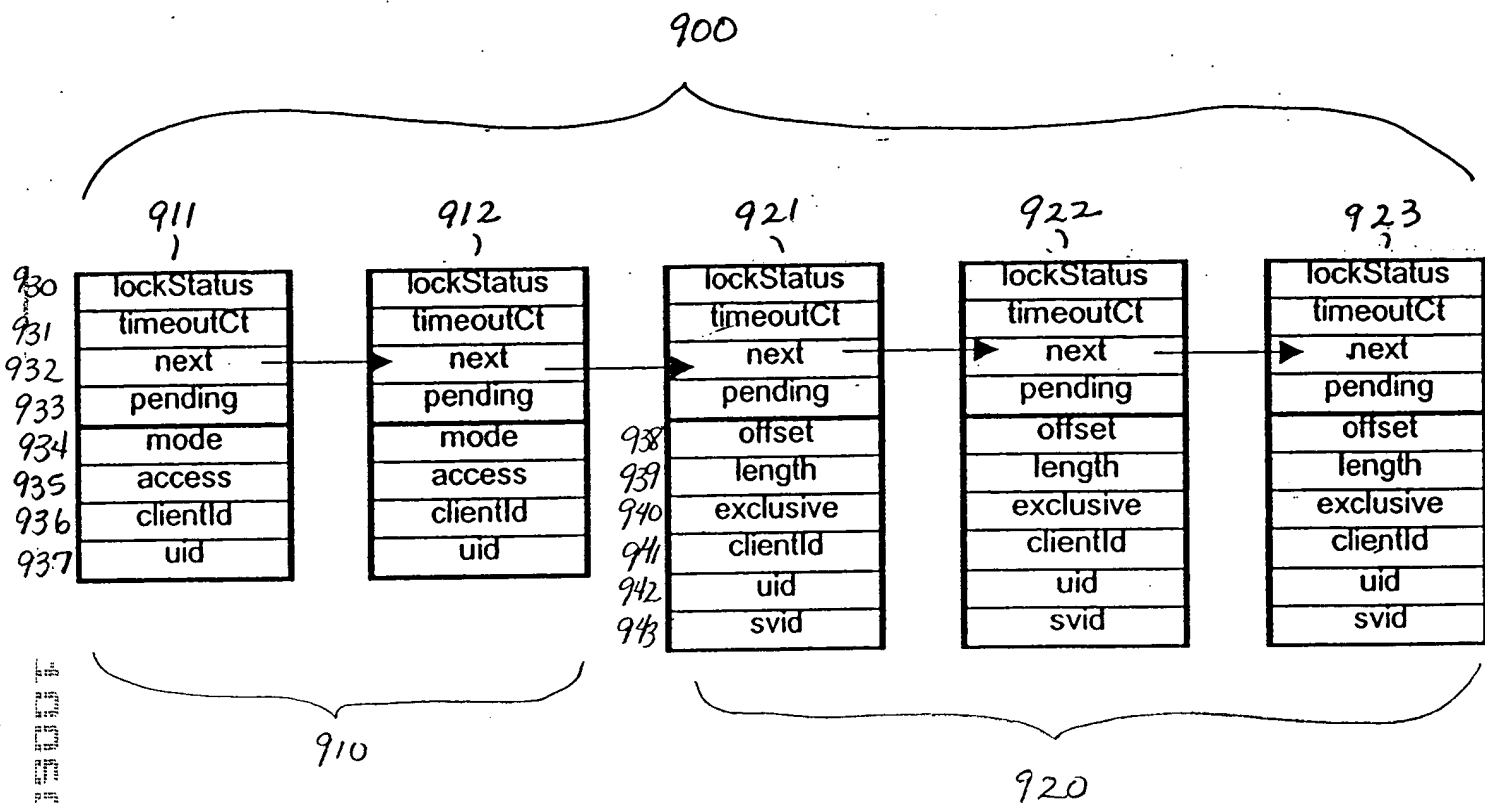


FIGURE 9 - A Sample Lock String

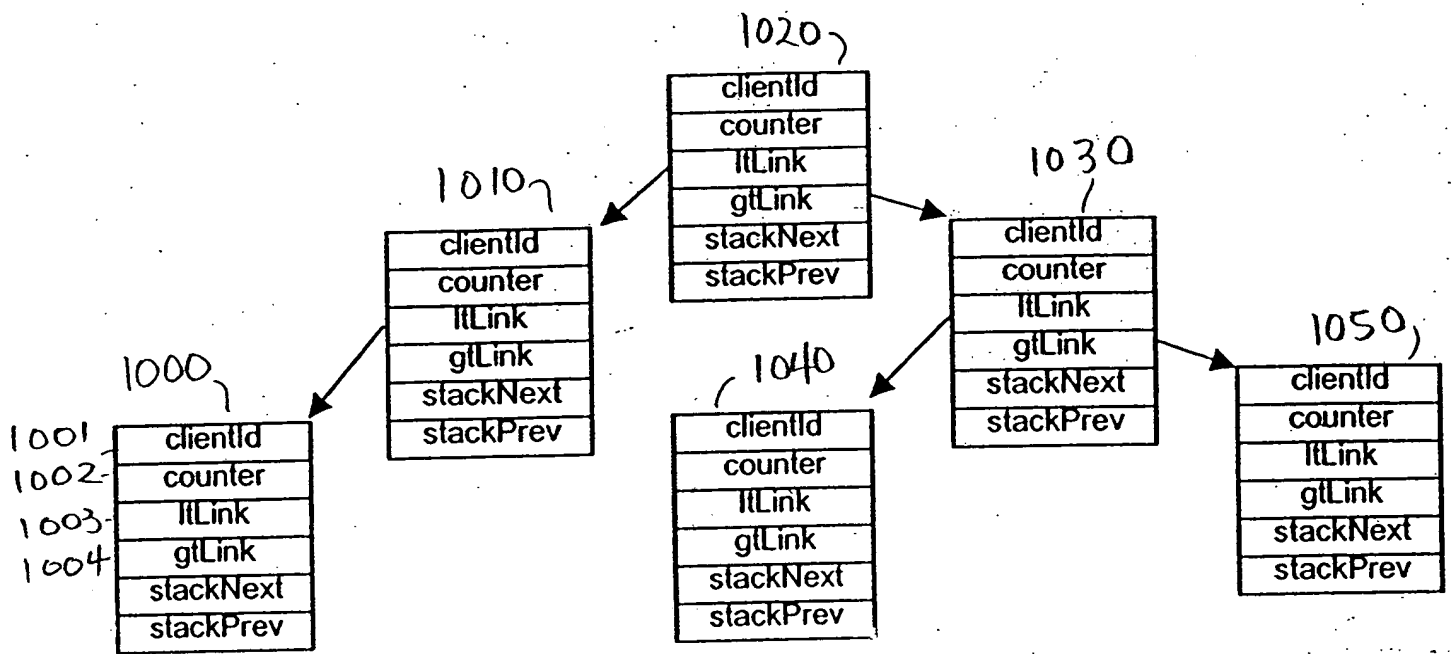


FIGURE 10 - Refresh Nodes configured as a binary tree.

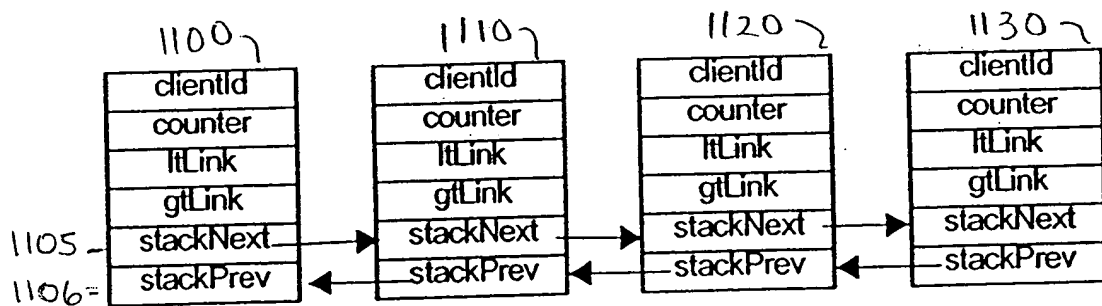


FIGURE 11 - Refresh Nodes configured as a doubly-linked list

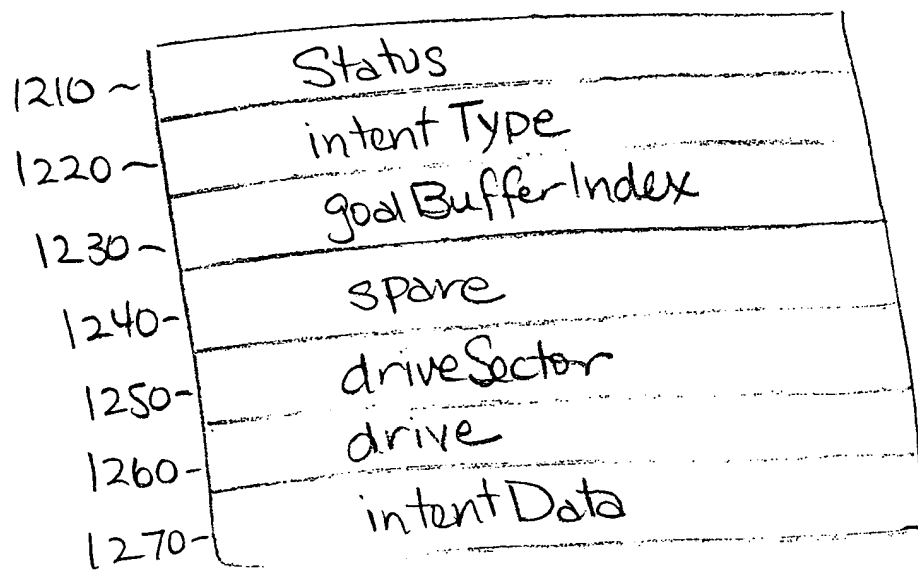


FIGURE 12 - Structure of an Intent Log Entry

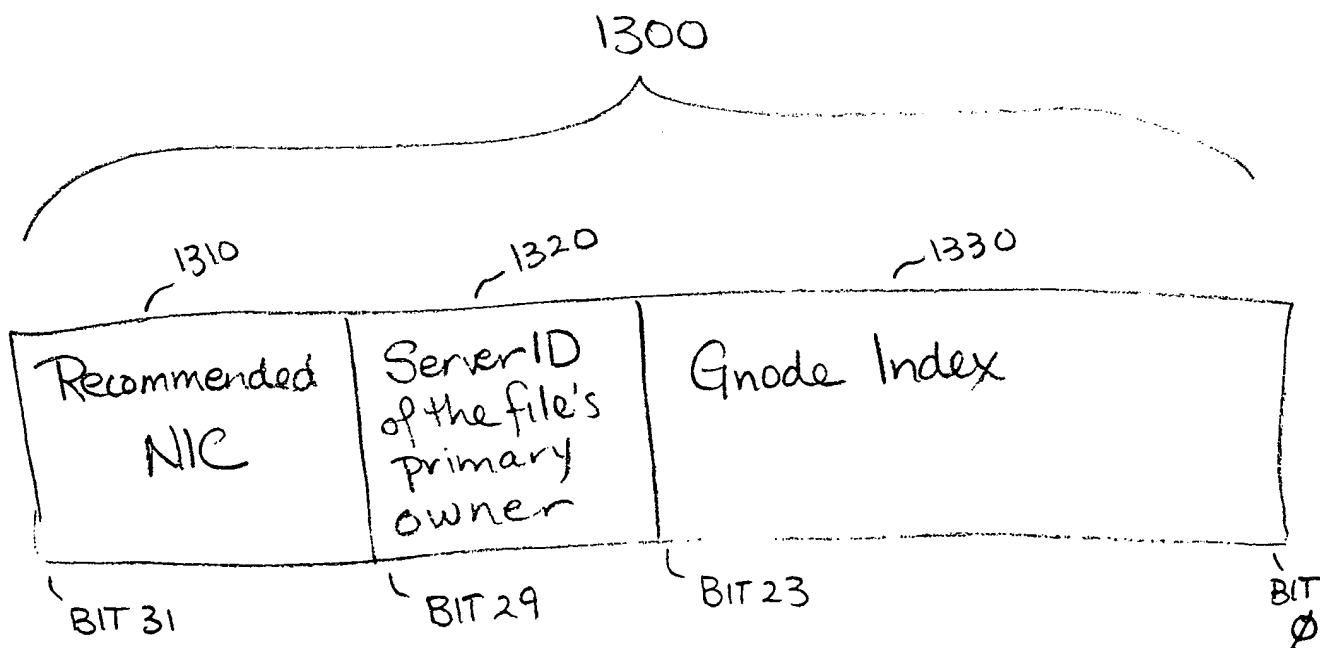


FIGURE 13 - Structure of a File Handle

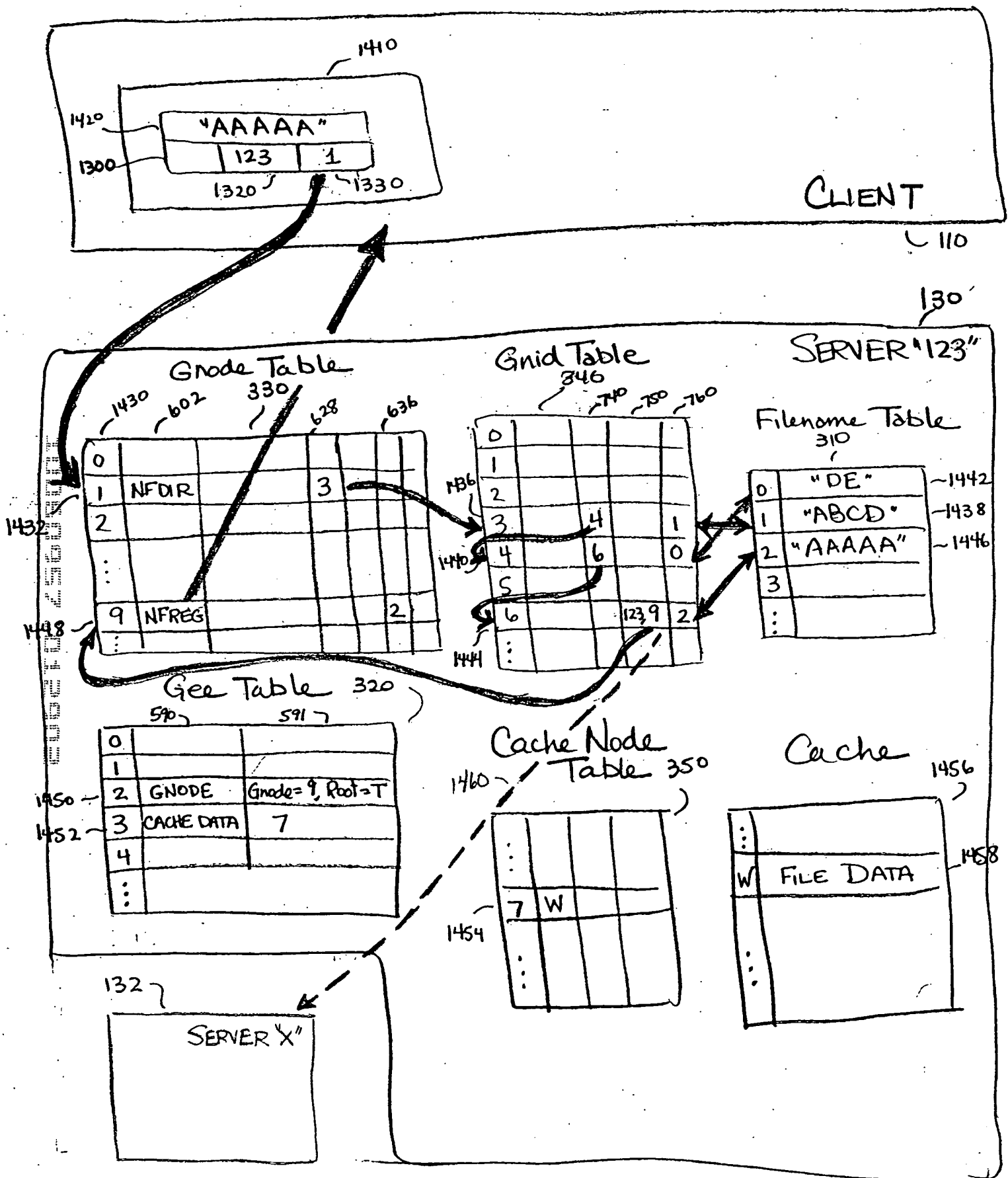


FIGURE 14a: Example of a File Look-Up

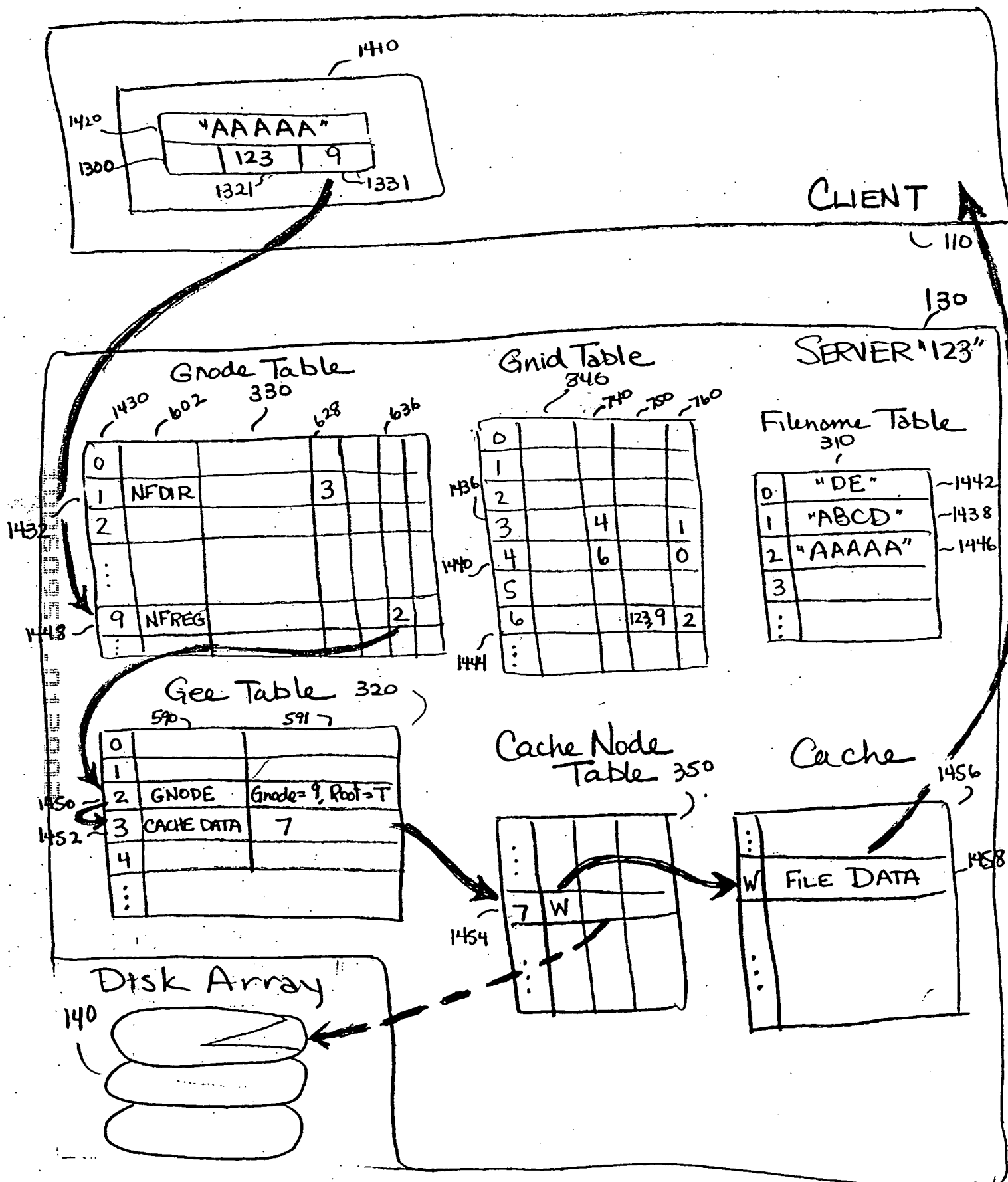


FIGURE 14b Example of a File Access

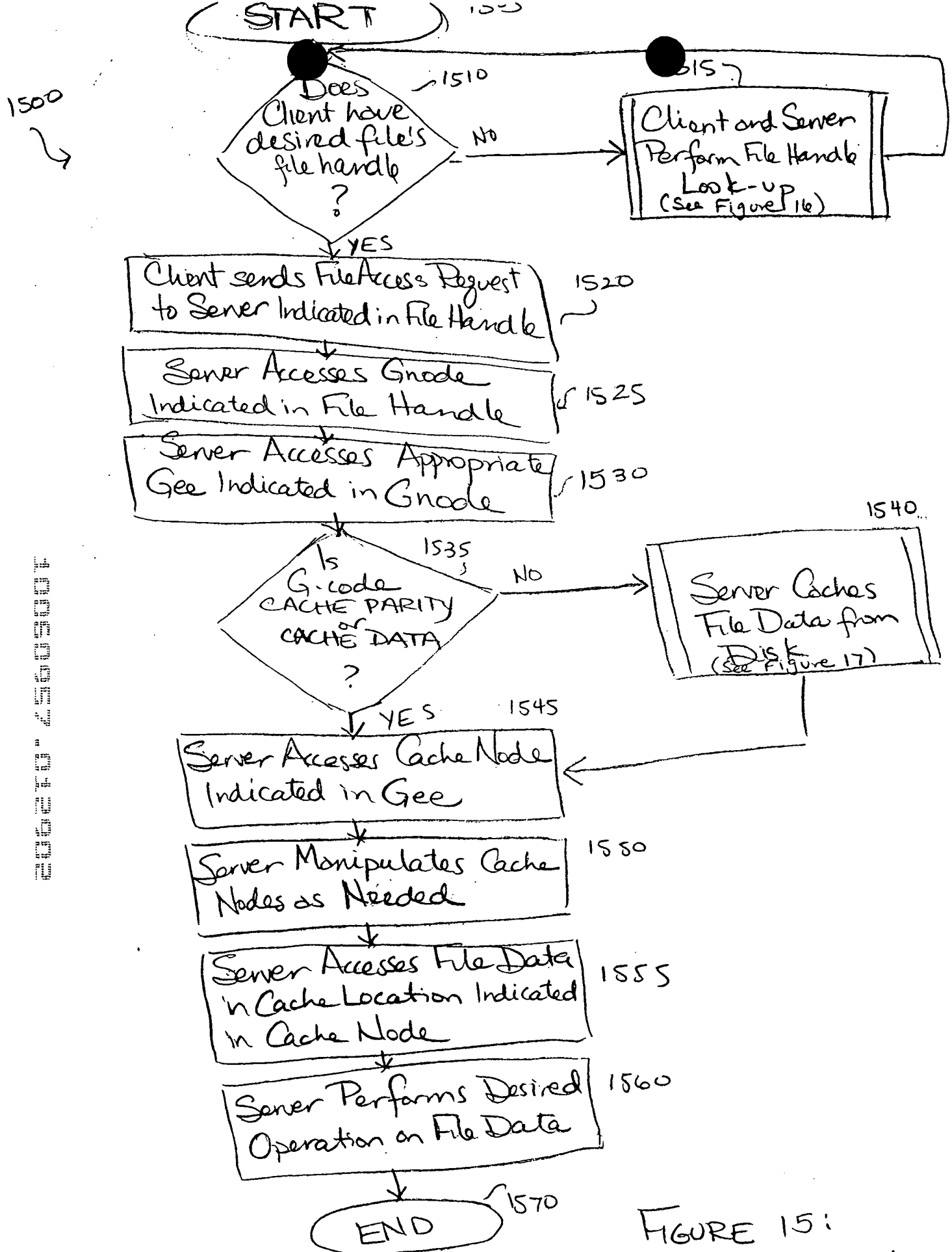


FIGURE 15:
Performing a File Access

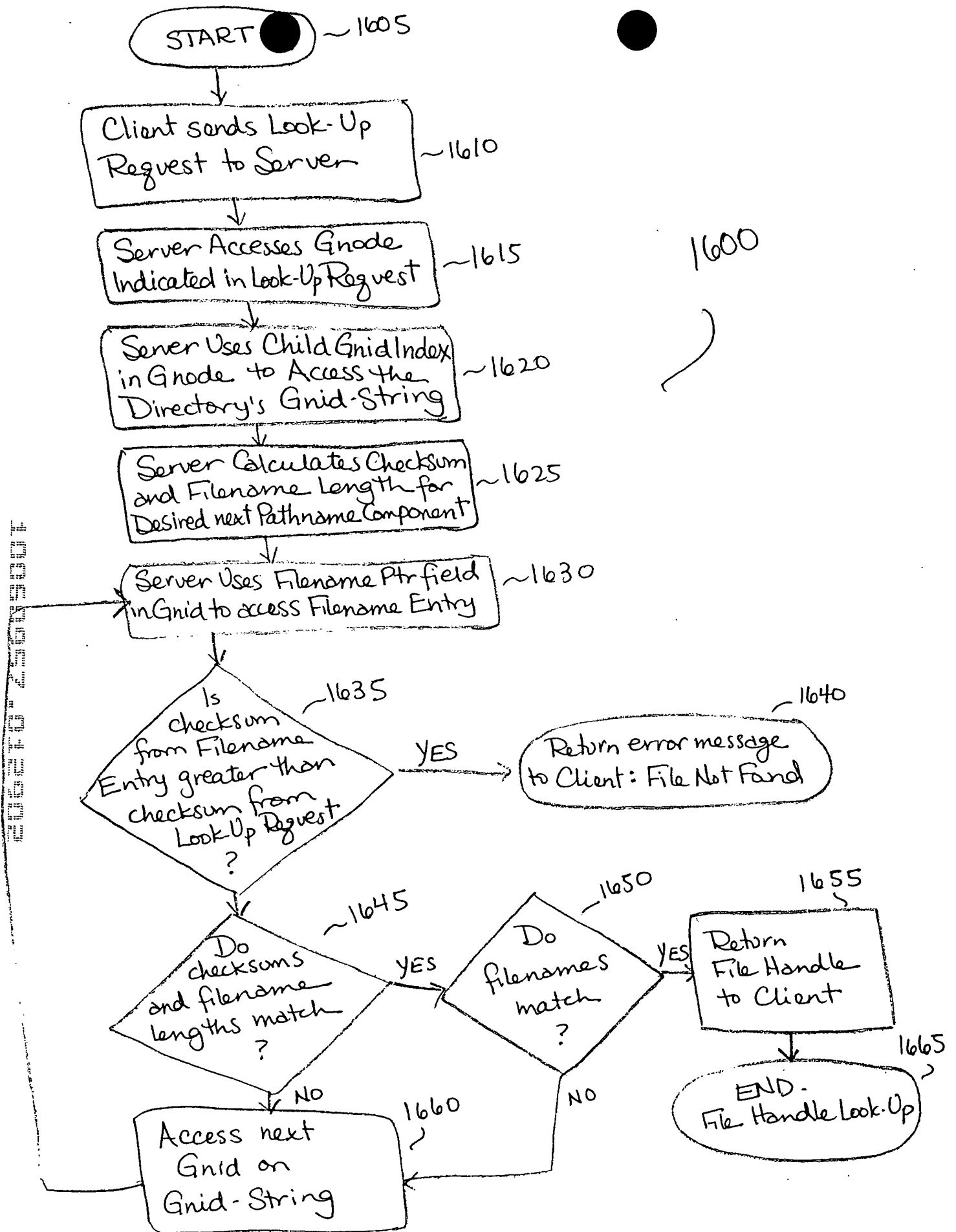


FIGURE 16: Performing a File Handle Look-Up

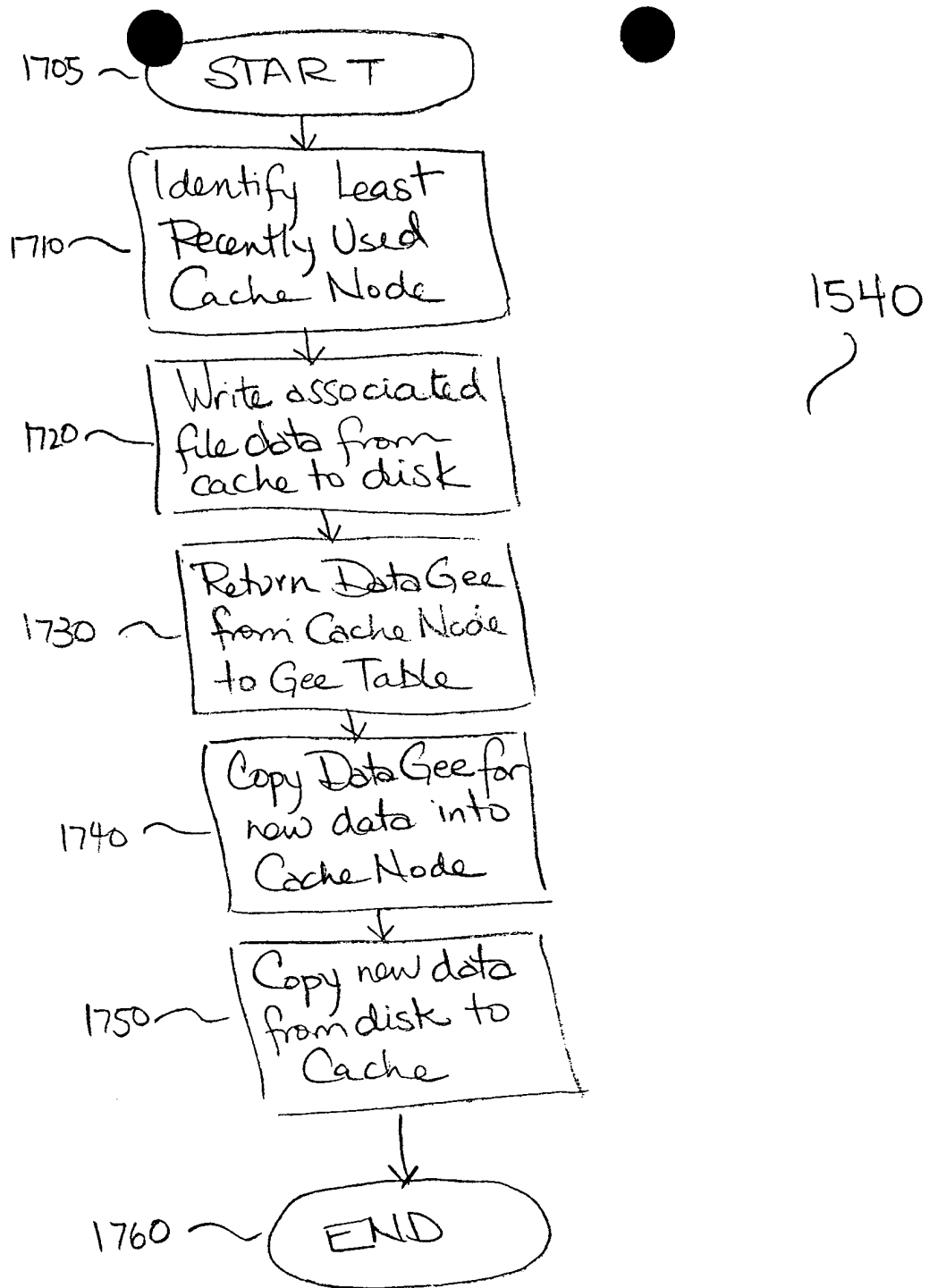


FIGURE 17: Caching File Data

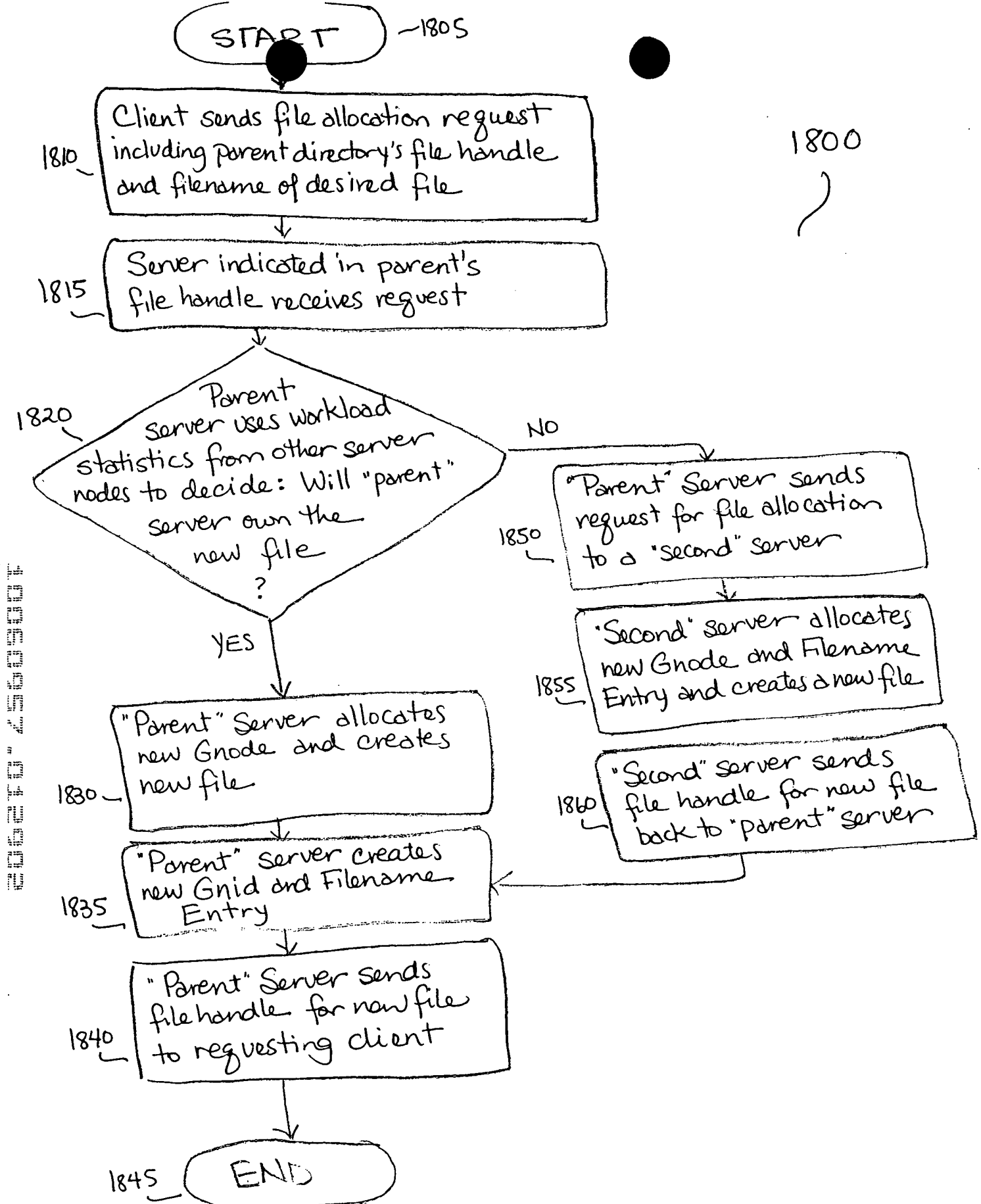


FIGURE 18 - File Allocation

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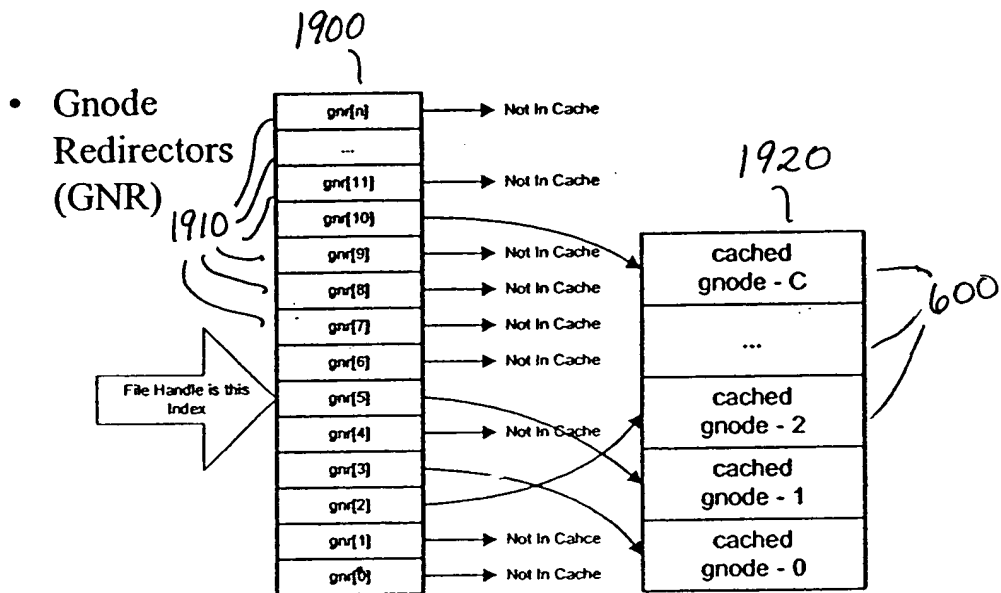


FIGURE 19

2000

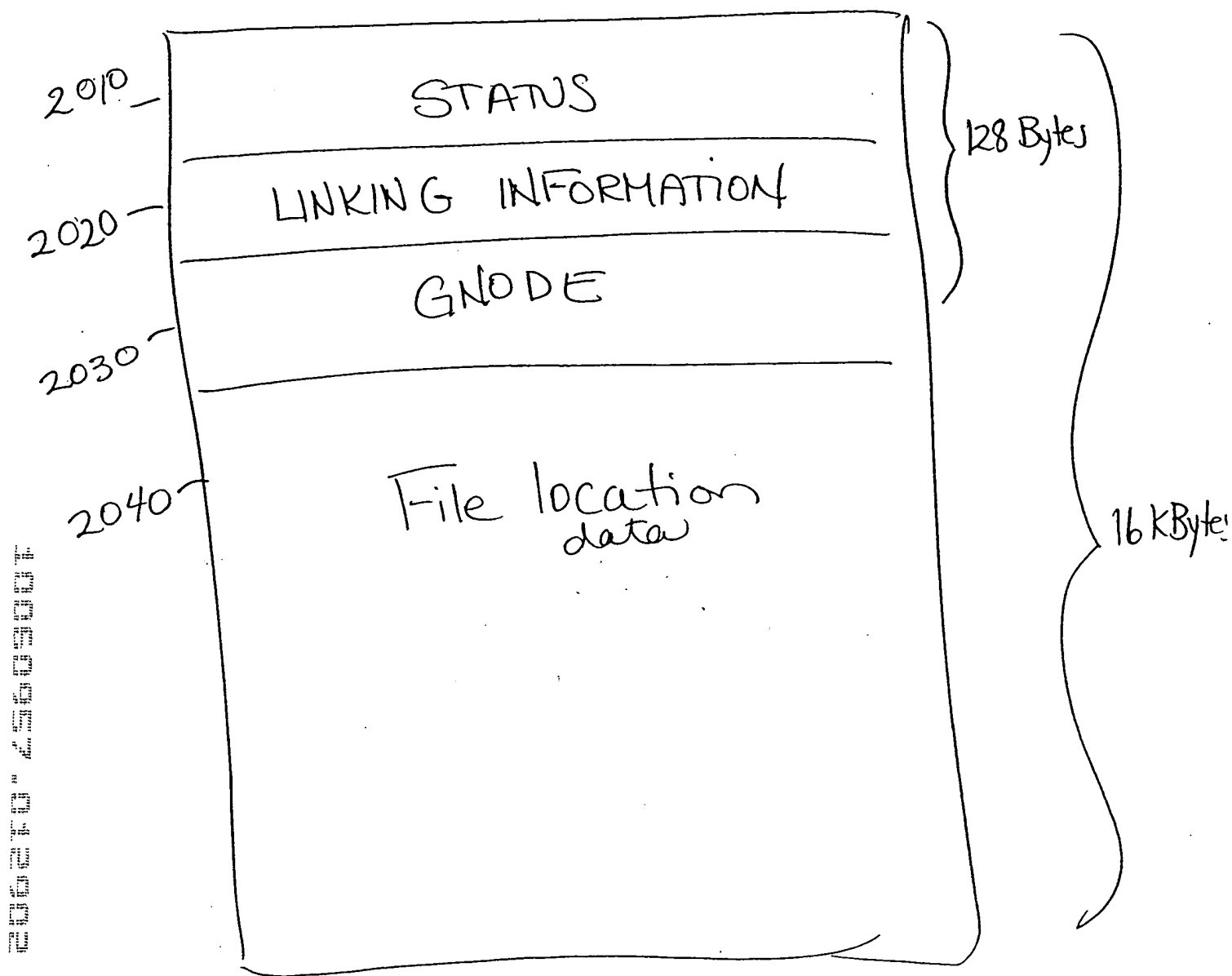


Figure 20a

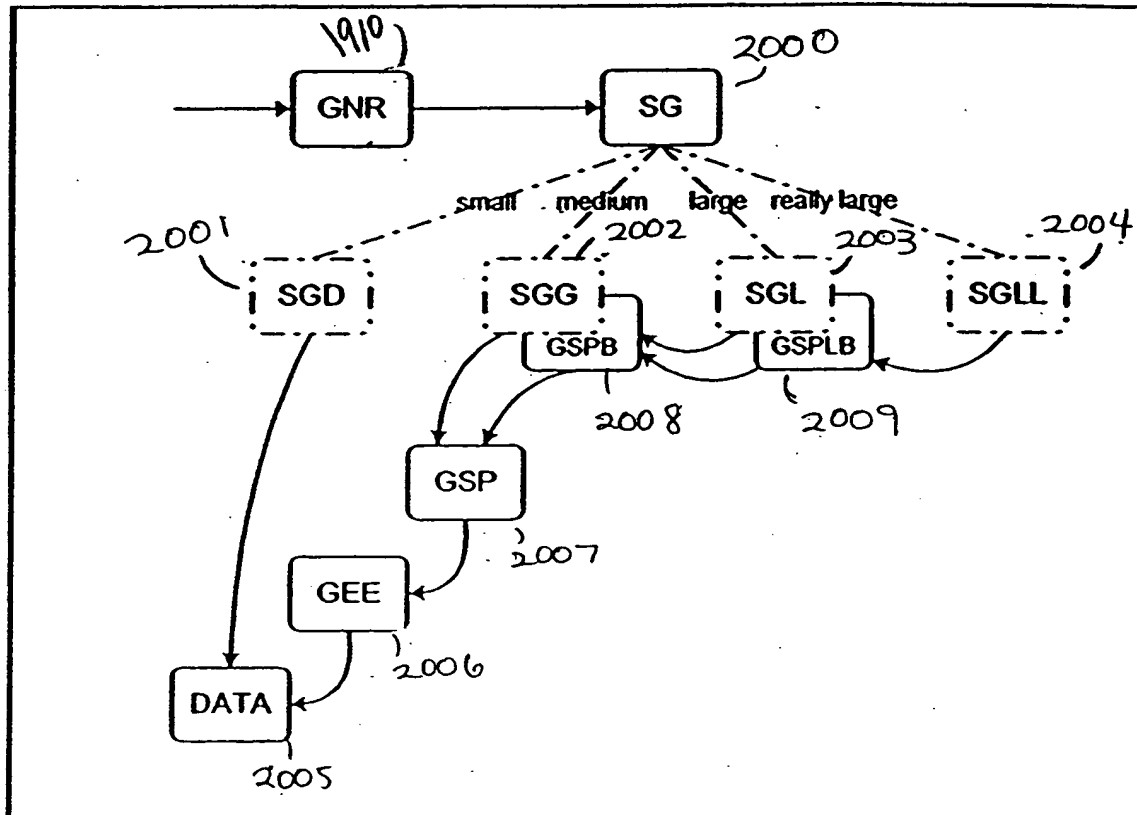


FIGURE 20b

CONVENTIONAL RAID MAPPING (PRIOR ART)

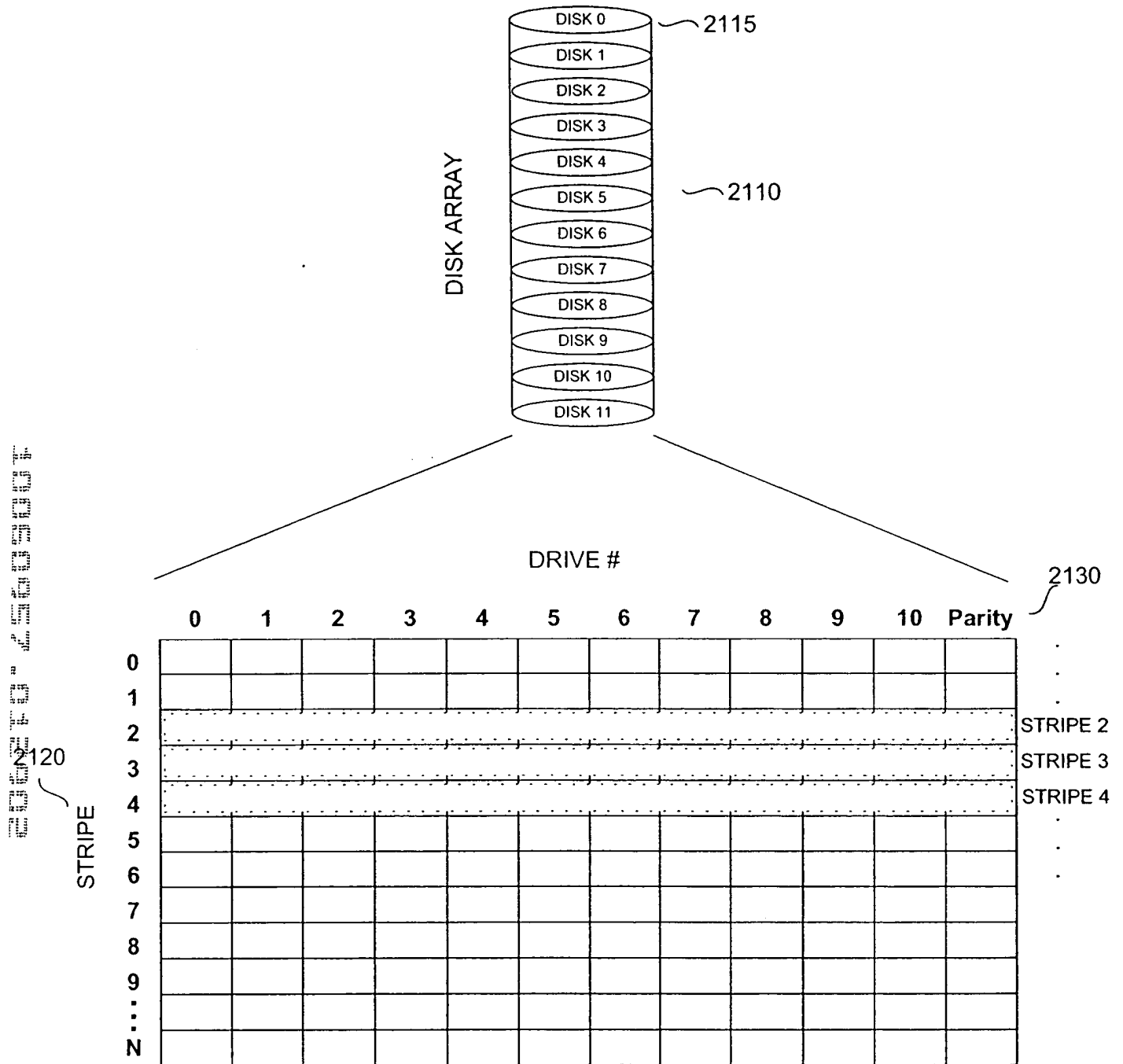


FIGURE 21

FIGURE 22A

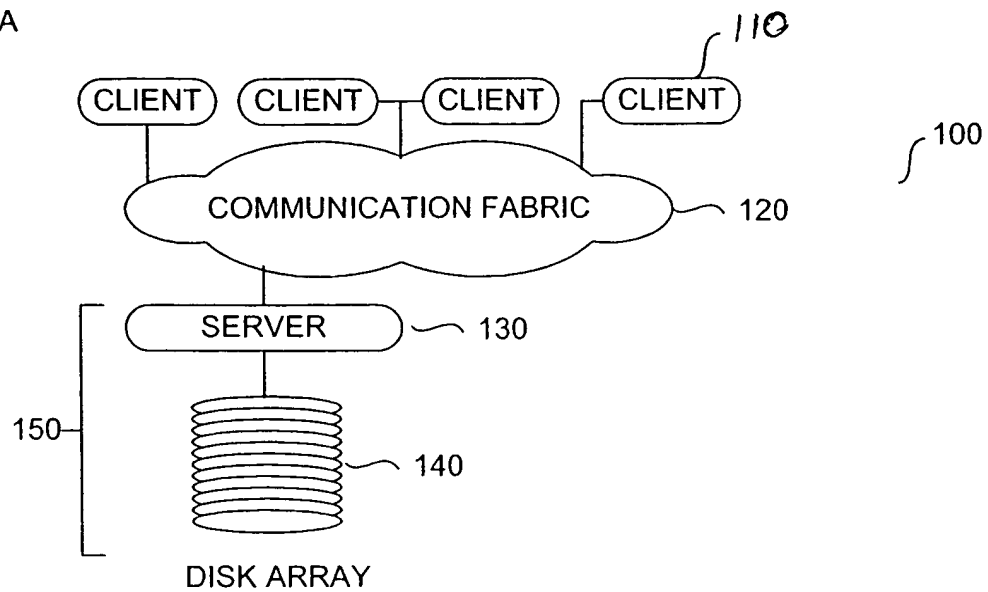


FIGURE 22B

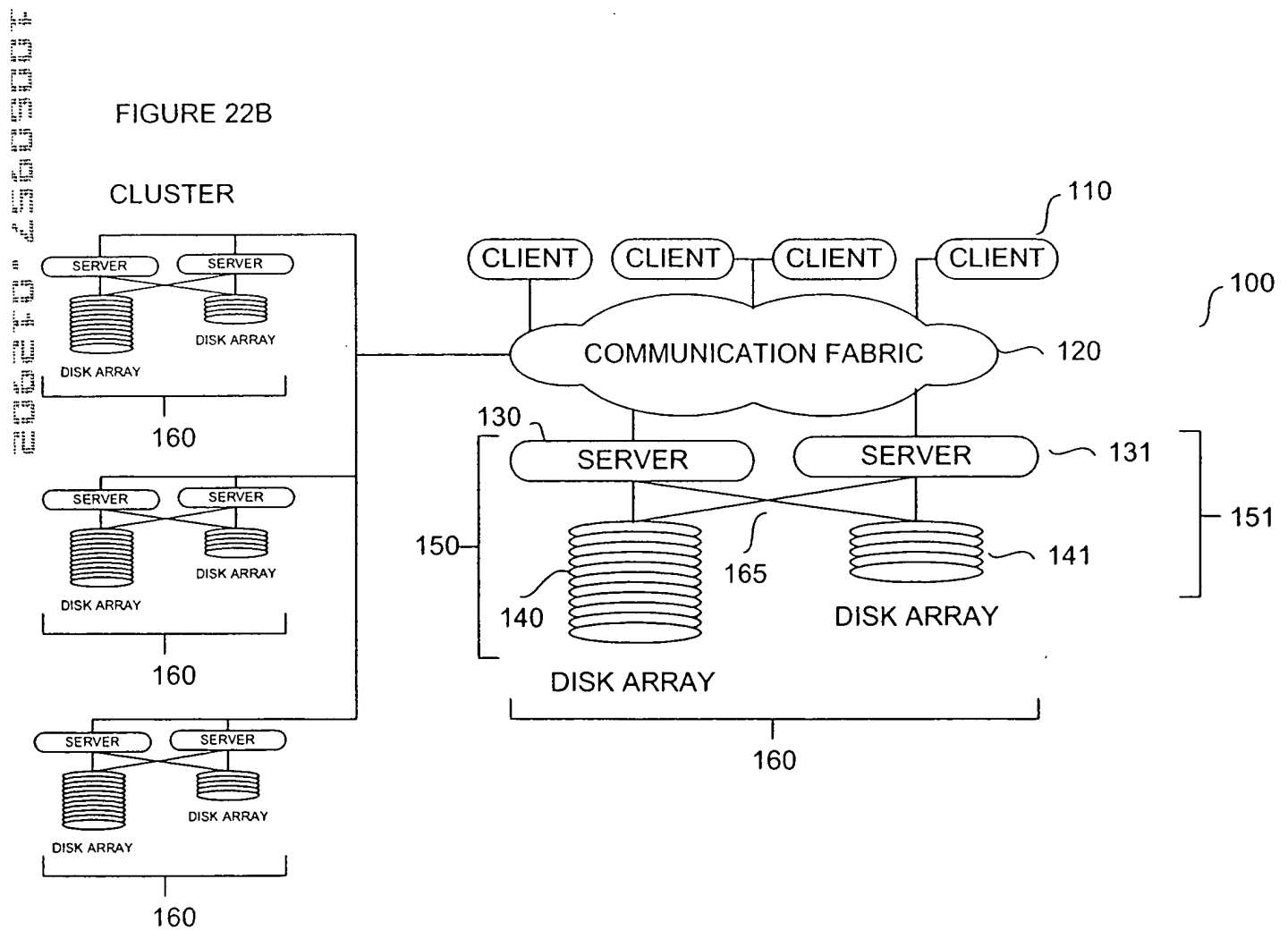


FIGURE 23

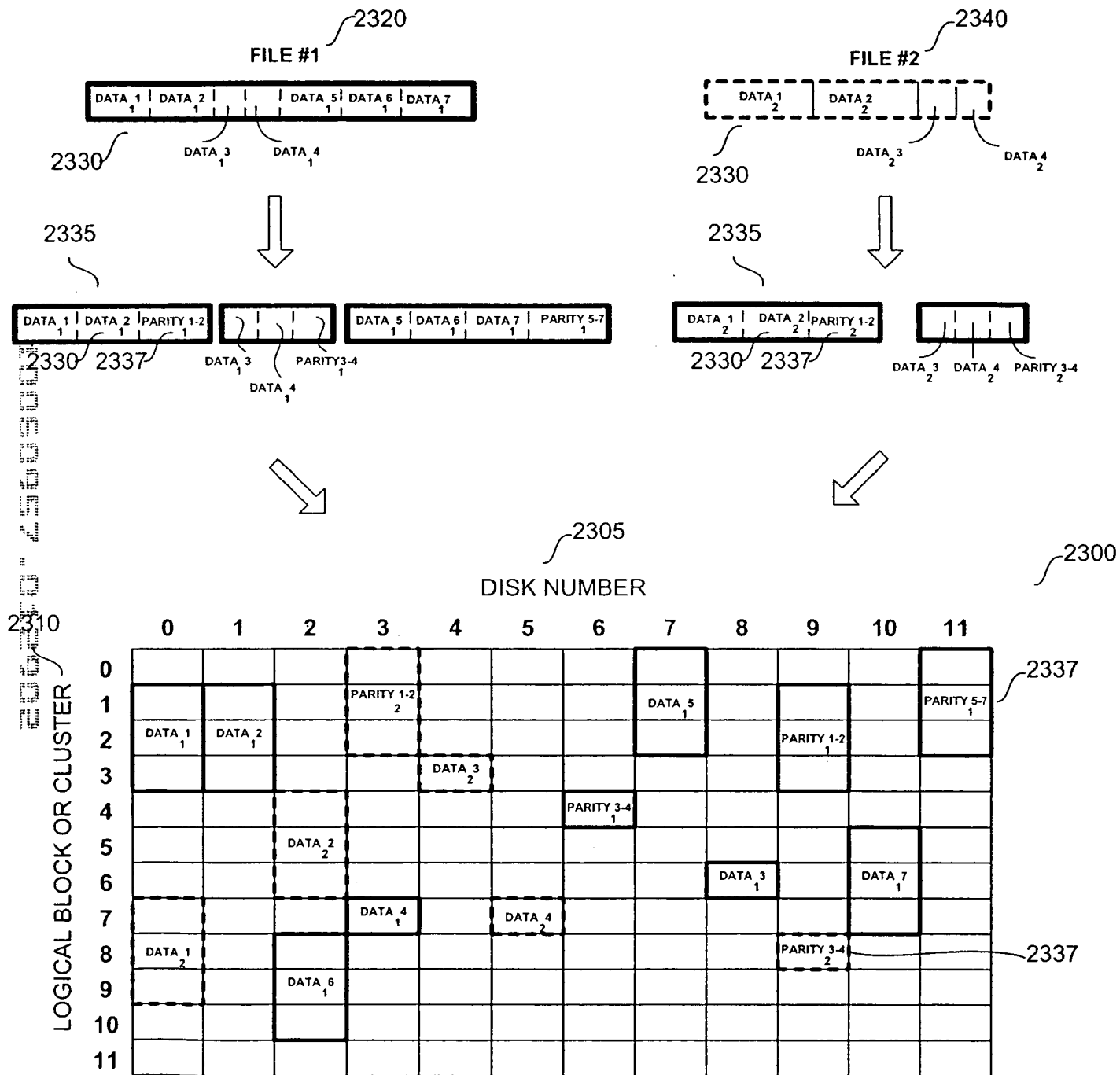


FIGURE 24A

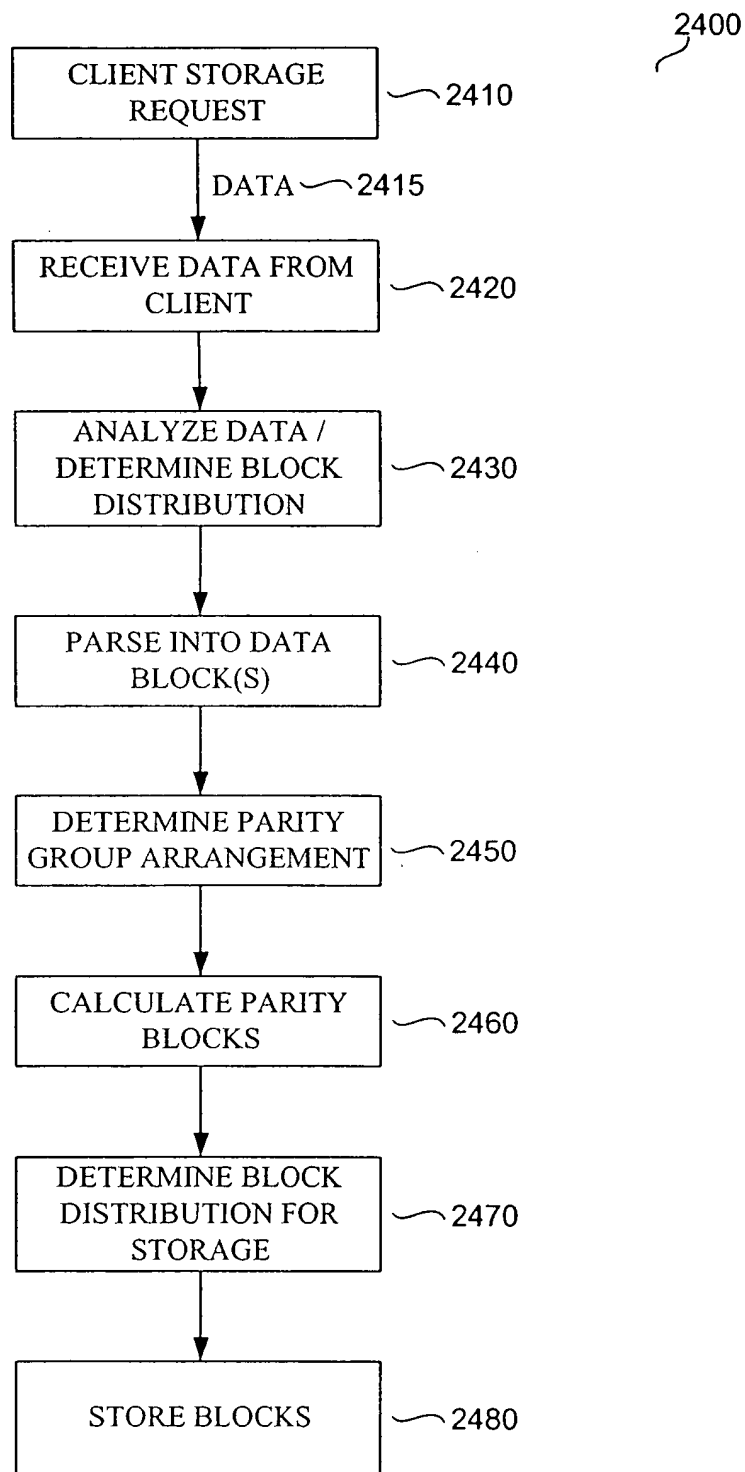
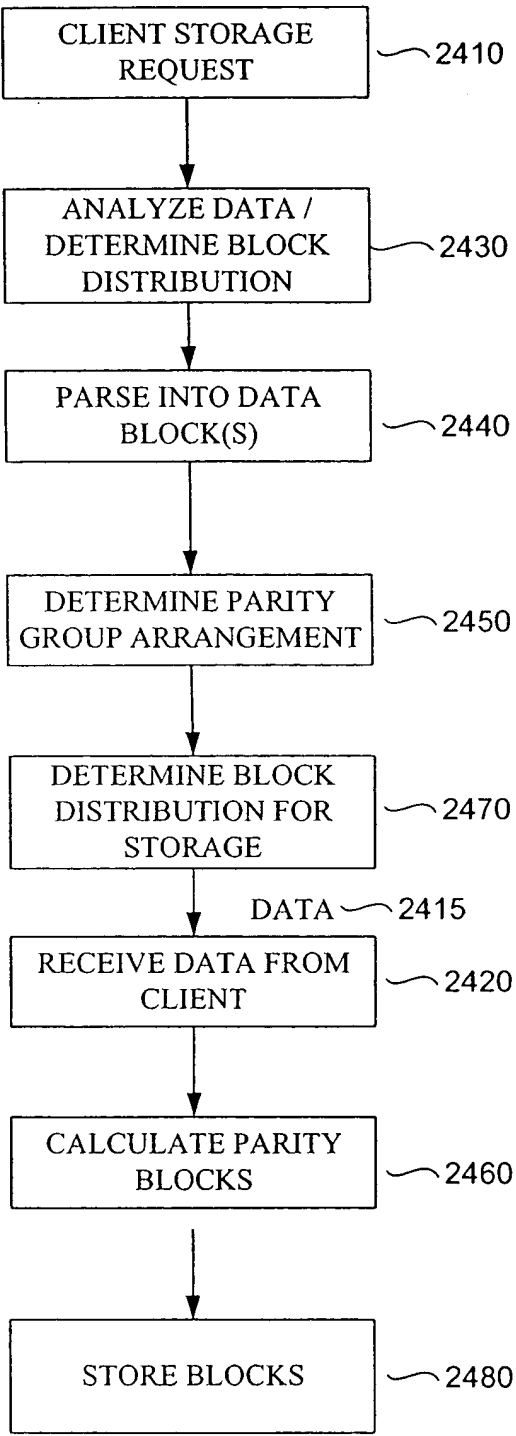


FIGURE 24B



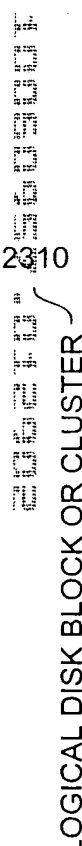


FIGURE 26A

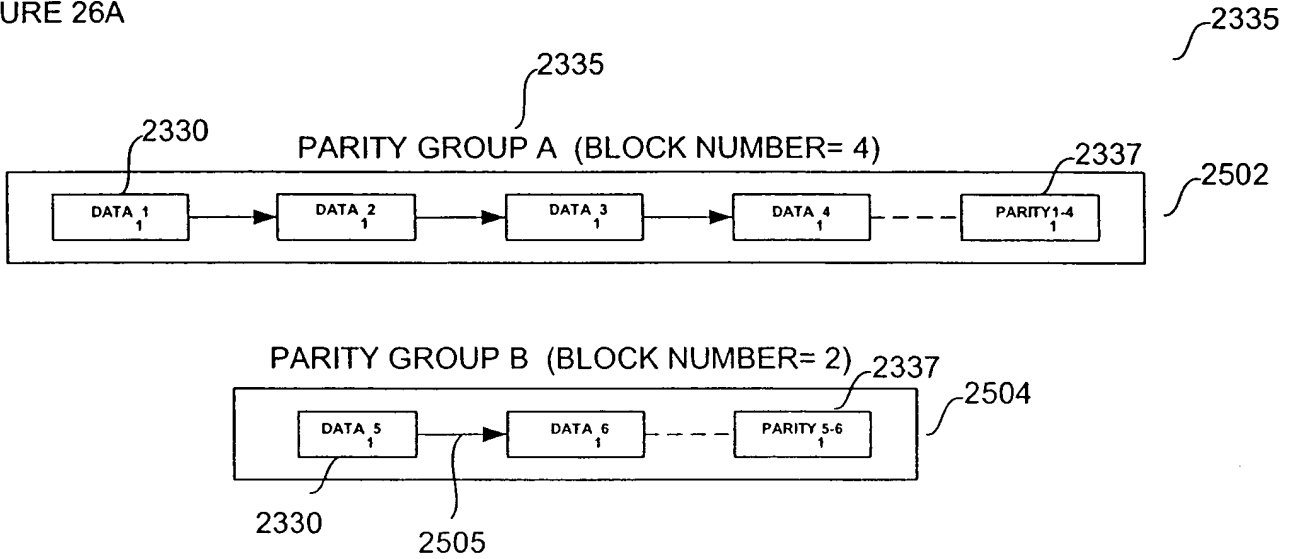
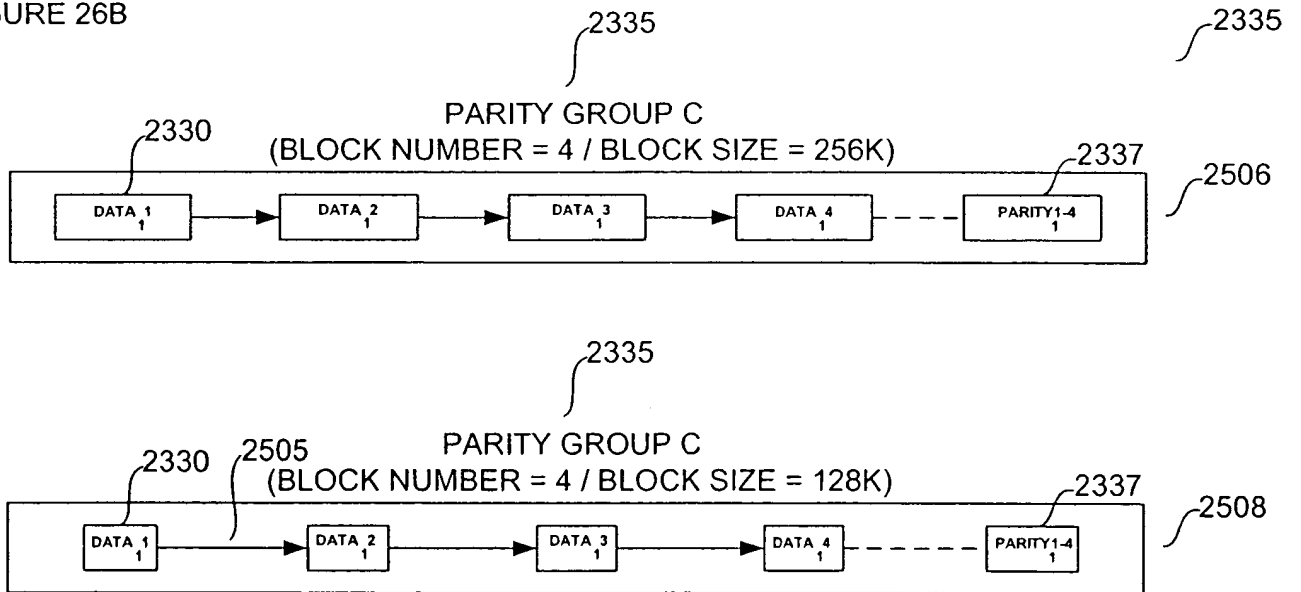


FIGURE 26B



DISK ARRAY INITIALIZATION USING GEE TABLE SPACE ALLOCATION

2530

2532	2534	2536	
INDEX	G-CODE	DATA	2542
...	
45	GNODE	EXTENT=2	
46	DATA	BLOCKS 456, 457: Drive 13	
47	DATA	BLOCKS 667, 668: Drive 15	
48	DATA	BLOCKS 112, 113: Drive 19	
49	PARITY	BLOCKS 554, 555: Drive 2	
...	
76	GNODE	EXTENT=3	
77	DATA	BLOCKS 460, 461, 462: Drive 13	
78	DATA	BLOCKS 671, 672, 673: Drive 15	
79	PARITY	BLOCKS 121, 122, 123: Drive 19	
...	
88	GNODE	EXTENT=2	
89	DATA	BLOCKS 463, 464, 465: Drive 2	
90	DATA	BLOCKS 674, 675, 676: Drive 5	
91	PARITY	BLOCKS 124, 125, 126: Drive 13	
...			

FIGURE 27

ARRAY PREPARATION / G-TABLE FORMATTING

2448

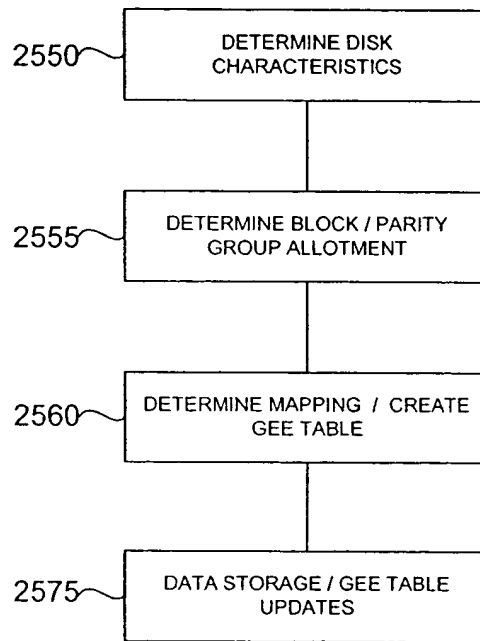


FIGURE 28

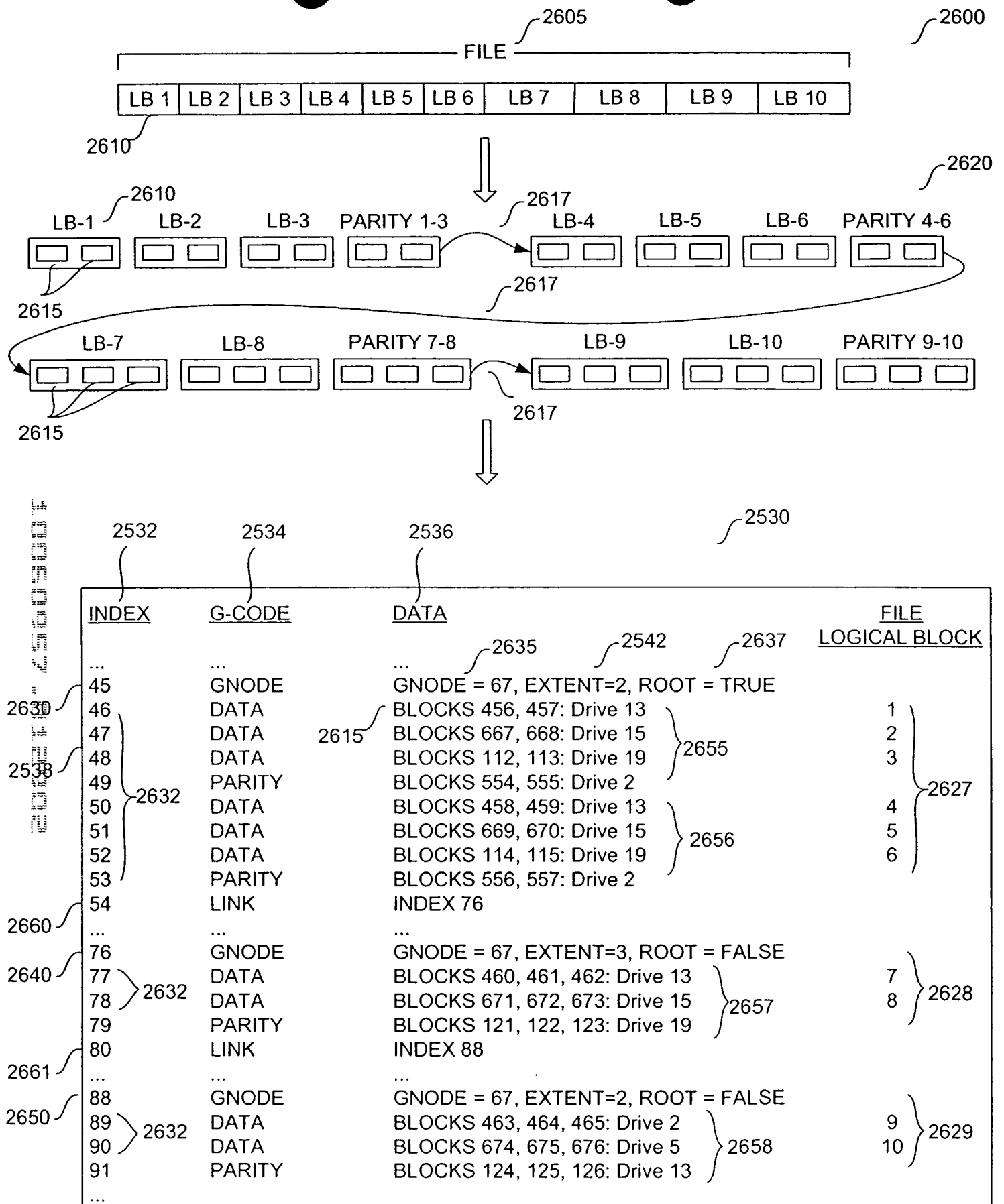


FIGURE 29

DRIVE FAILURE RECOVERY MECHANISM

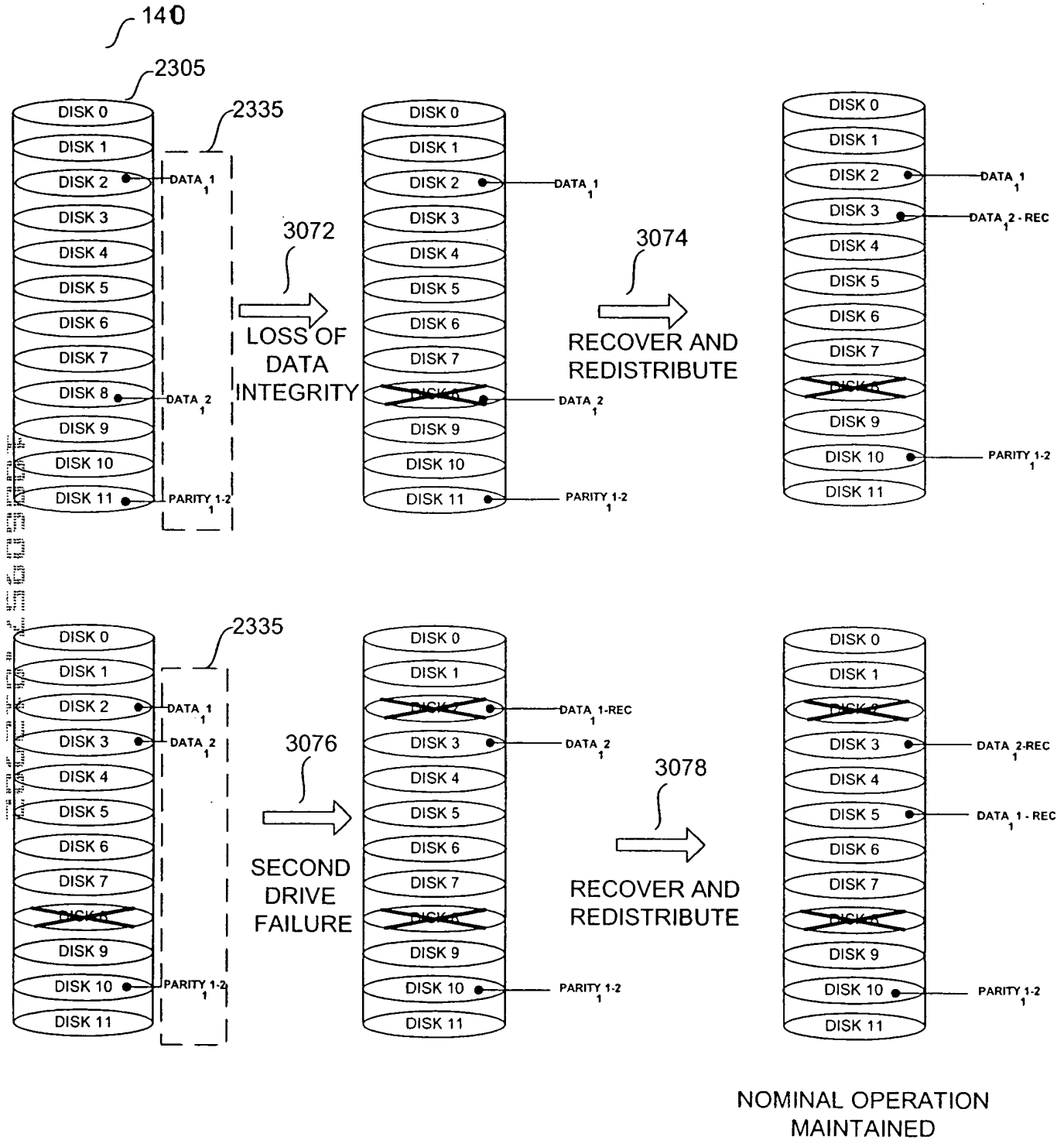


FIGURE 30

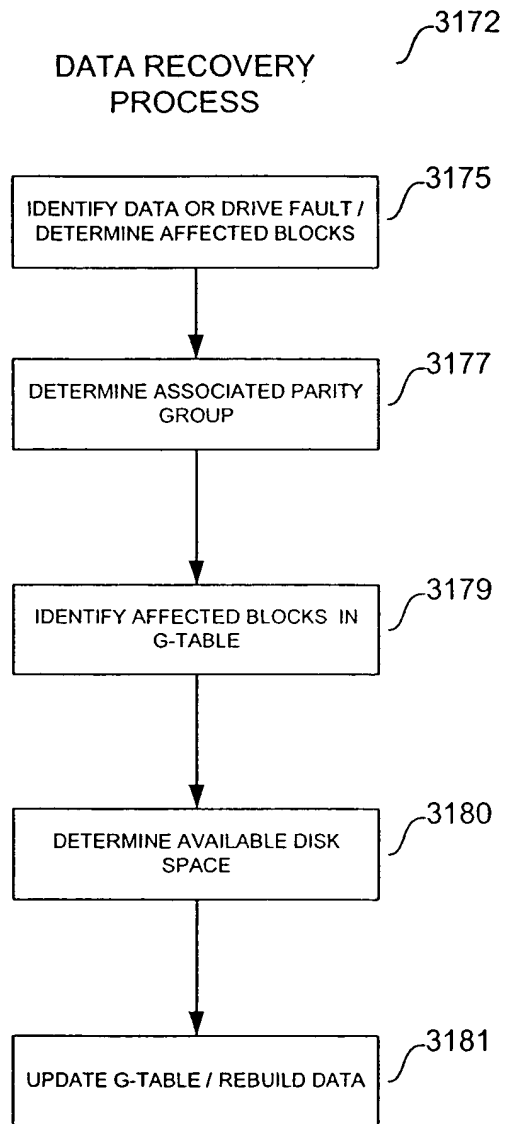


FIGURE 31

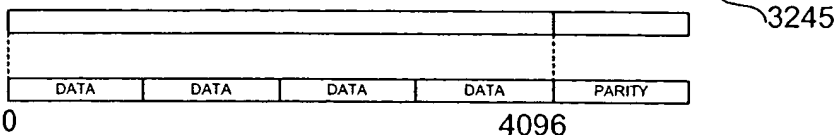
FILE #1

FIGURE 32A



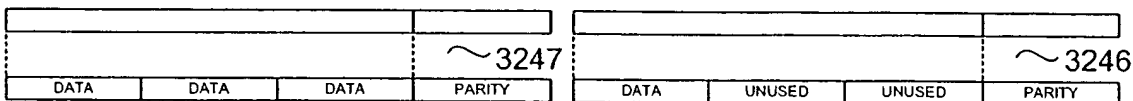
FILE #1 W/ PARITY -- 4-BLOCK PARITY GROUP -- EXTENT = 2
5120 BYTES TOTAL / UTILIZATION = 100%

3240



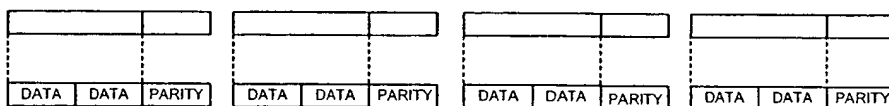
FILE #1 W/ PARITY -- 3-BLOCK PARITY GROUP -- EXTENT = 2
8192 BYTES TOTAL / UTILIZATION = 66%

3241



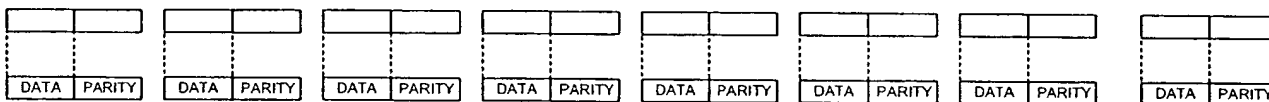
FILE #1 W/ PARITY -- 2-BLOCK PARITY GROUP -- EXTENT = 1
6144 BYTES TOTAL / UTILIZATION = 100%

3242



FILE #1 W/ PARITY -- 1-BLOCK PARITY GROUP -- EXTENT = 1
8192 BYTES TOTAL / UTILIZATION = 100%

3243



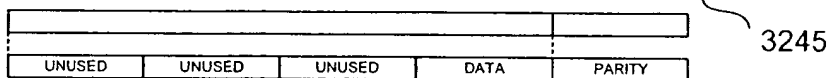
FILE #2

0 1024

FIGURE 32B

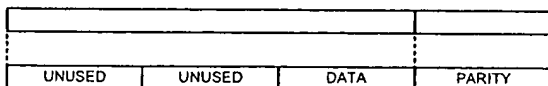
FILE #2 W/ PARITY -- 4-BLOCK PARITY GROUP -- EXTENT = 2
5120 BYTES TOTAL / UTILIZATION = 25%

3250



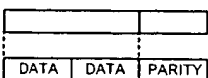
FILE #2 W/ PARITY -- 3-BLOCK PARITY GROUP -- EXTENT = 2
4096 BYTES TOTAL / UTILIZATION = 33%

3251



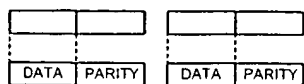
FILE #2 W/ PARITY -- 2-BLOCK PARITY GROUP -- EXTENT = 1
1536 BYTES TOTAL / UTILIZATION = 100%

3252



FILE #2 W/ PARITY -- 1-BLOCK PARITY GROUP -- EXTENT = 1
2048 BYTES TOTAL / UTILIZATION = 100%

3253



3360

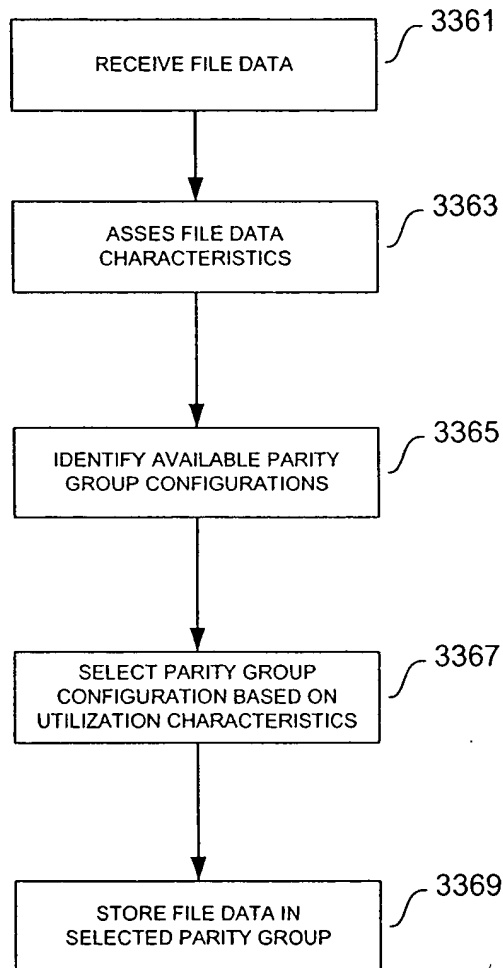


FIGURE 33

FIGURE 34A

			INITIAL ALLOCATION	DISK SPACE %
<div>DATA</div> <div>DATA</div> <div>DATA</div> <div>DATA</div> <div>PARITY</div>	4 block parity	3480	10000 groups	36%
<div>DATA</div> <div>DATA</div> <div>DATA</div> <div>PARITY</div>	3 block parity	3481	10000 groups	28%
<div>DATA</div> <div>DATA</div> <div>PARITY</div>	2 block parity	3482	10000 groups	22%
<div>DATA</div> <div>PARITY</div>	1 block parity	3483	10000 groups	14%

DISK USAGE

FIGURE 34B

		FREE	OCCUPIED	TOTAL	DISK SPACE %
3480	4 block parity	2500 groups	7500 groups	10000 groups	36%
3481	3 block parity	7500 groups	2500 groups	10000 groups	28%
3482	2 block parity	3500 groups	6500 groups	10000 groups	22%
3483	1 block parity	500 groups	9500 groups	10000 groups	14%

REDISTRIBUTION

FIGURE 34C

		FREE	OCCUPIED	TOTAL	DISK SPACE %
3480	4 block parity	2500 groups	7500 groups	10000 groups	36%
3481	3 block parity	2500 groups	2500 groups	5000 groups	14%
3482	2 block parity	3500 groups	6500 groups	10000 groups	22%
3483	1 block parity	10500 groups	9500 groups	20000 groups	28%

-5000 groups of 3 block parity

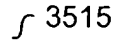
+10000 groups of 1 block parity

REDISTRIBUTION

3500

3510

PARITY GROUP DISSOLUTION



3535

3525



OR

3515

5-BLOCK PARITY GROUP

3600

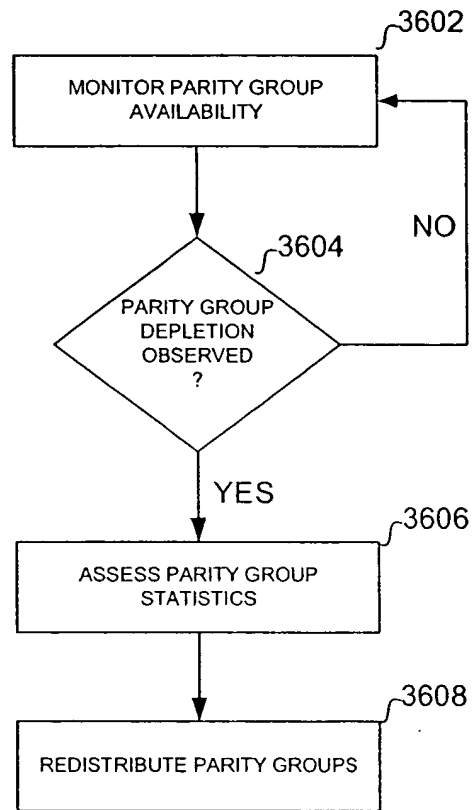


FIGURE 36

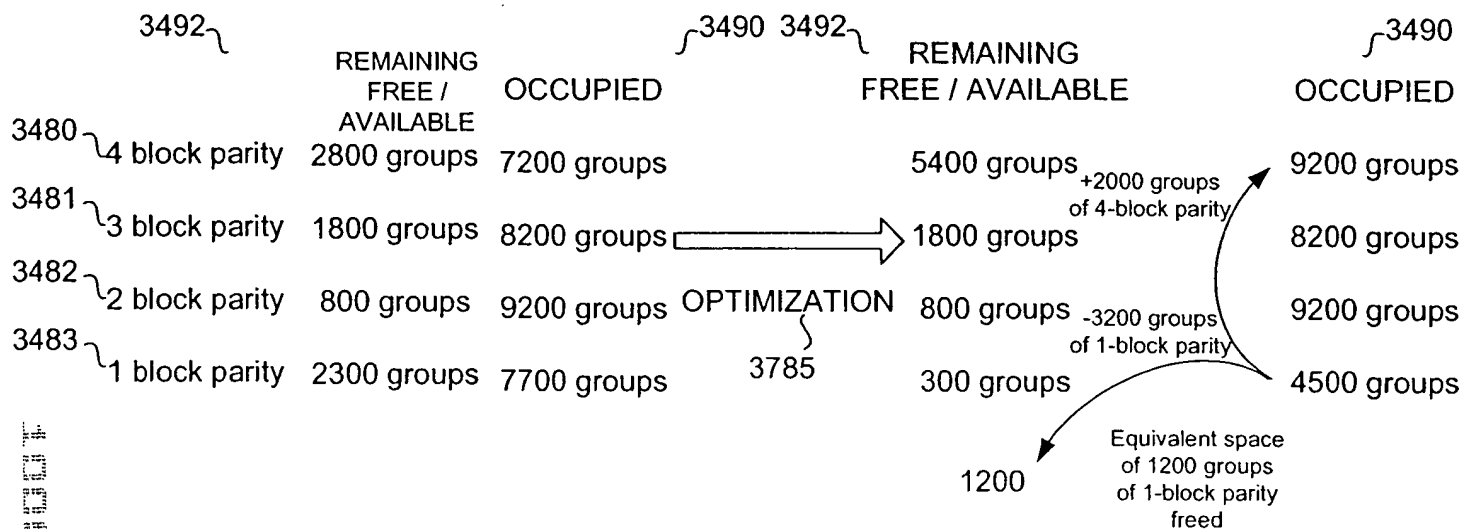


FIGURE 37

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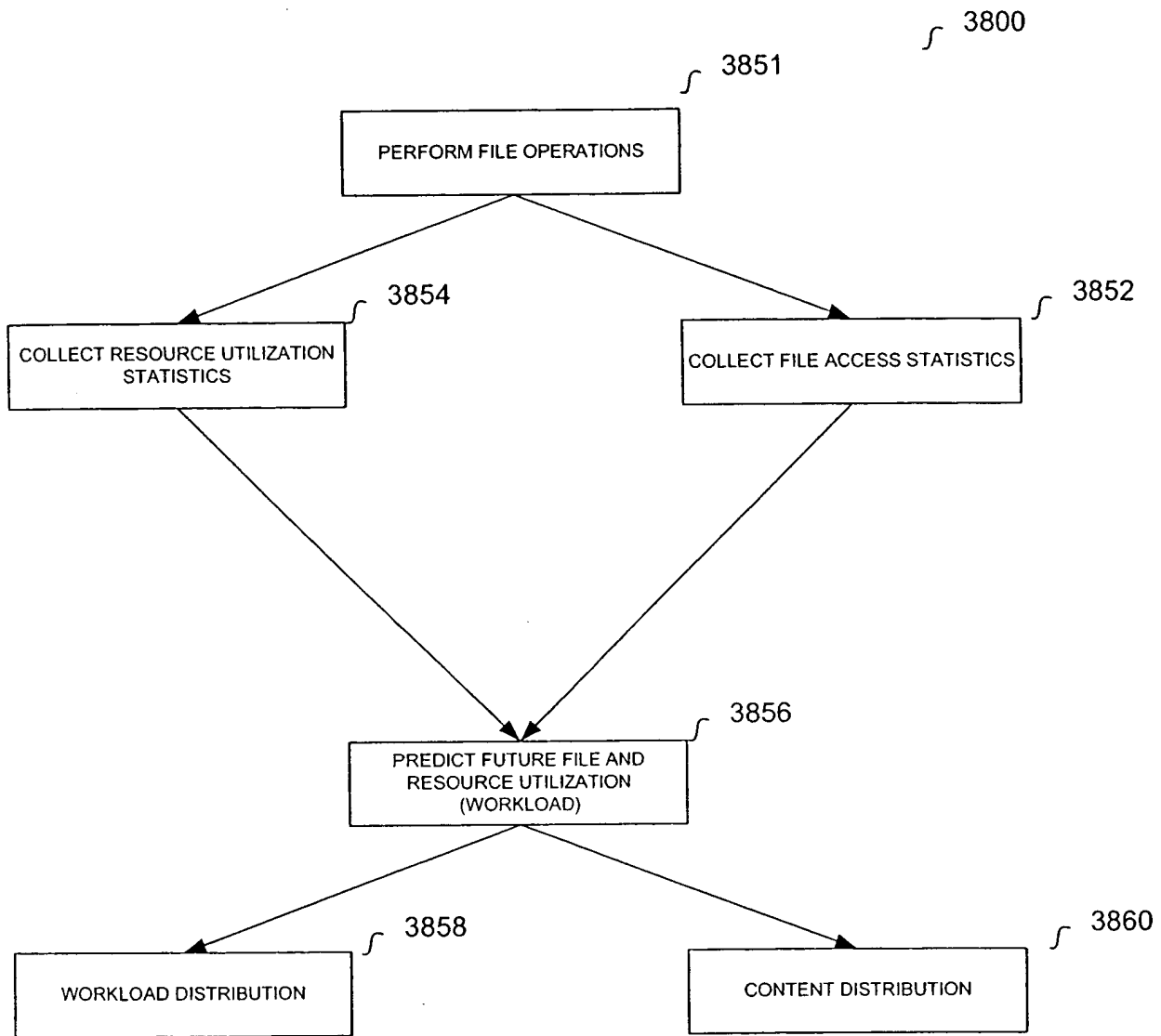


FIGURE 38

3900

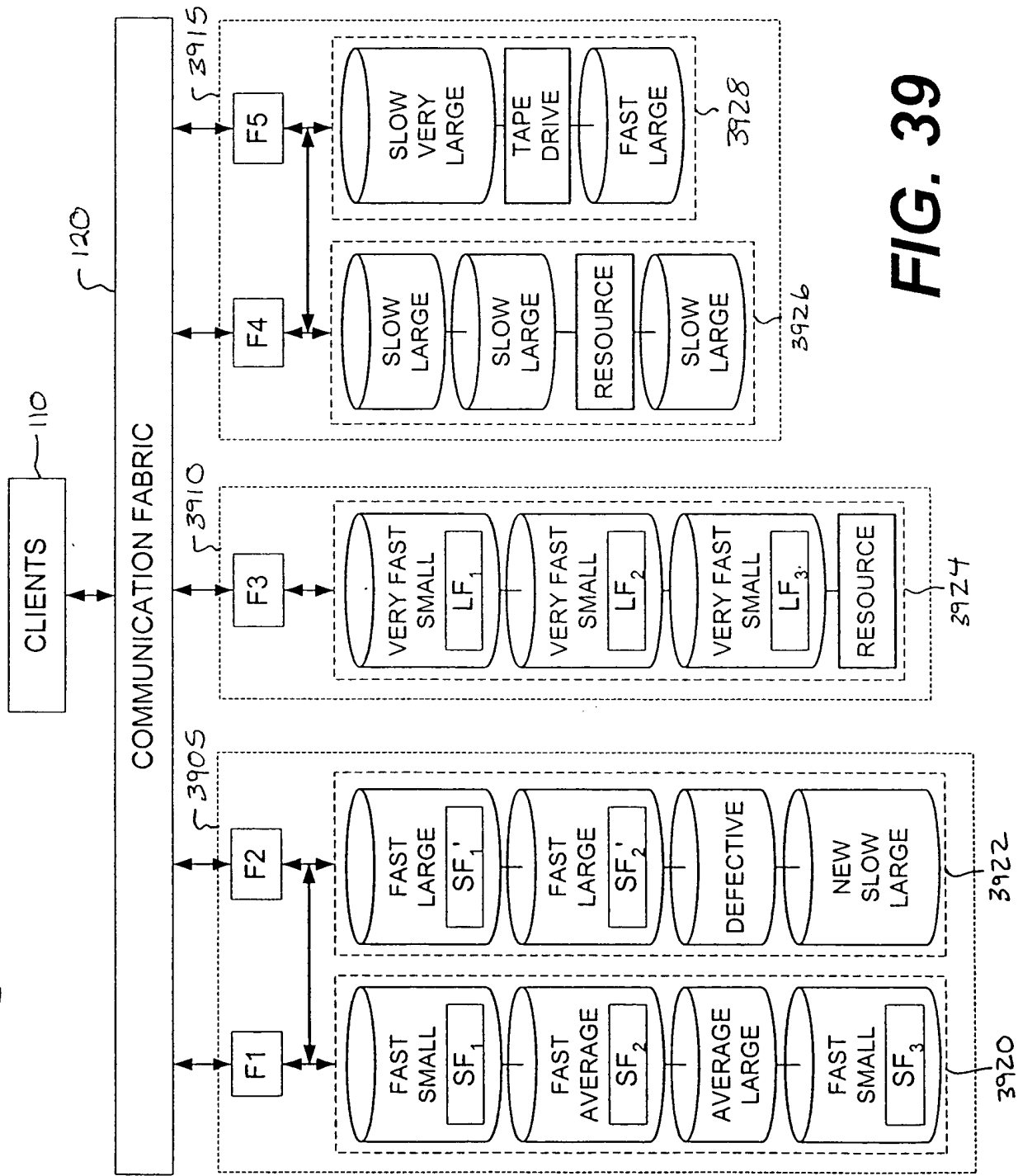


FIG. 39

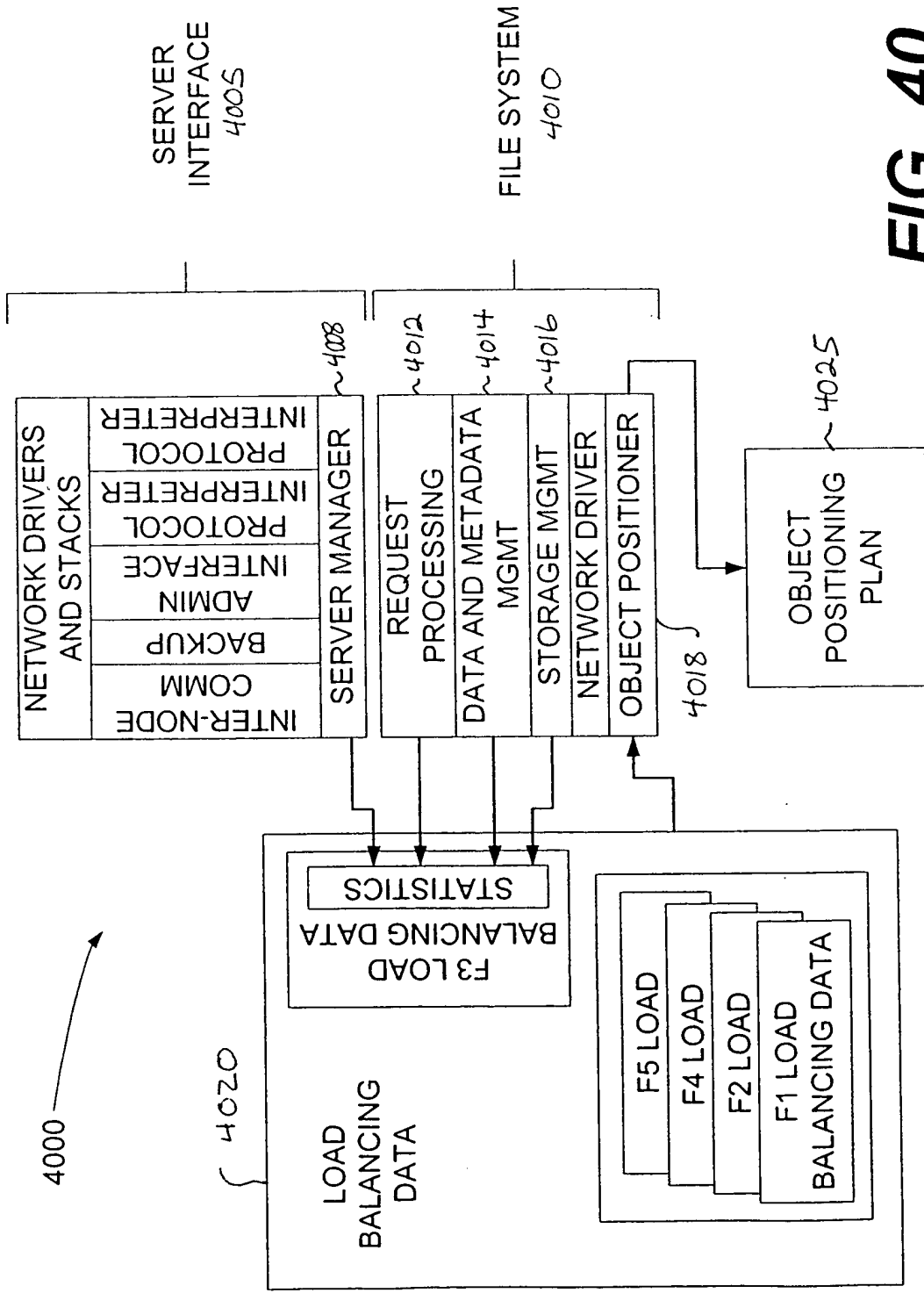


FIG. 40

F3 OBJECT POSITIONING PLAN

- Push LF to F4-F5 Cluster
- Issue File Handle For LF = Stale
- If Requested,
 - Send acceptance for copy of SF to F1
 - Create copy of SF
 - Send file handle of SF to F1

4025

FIG. 41

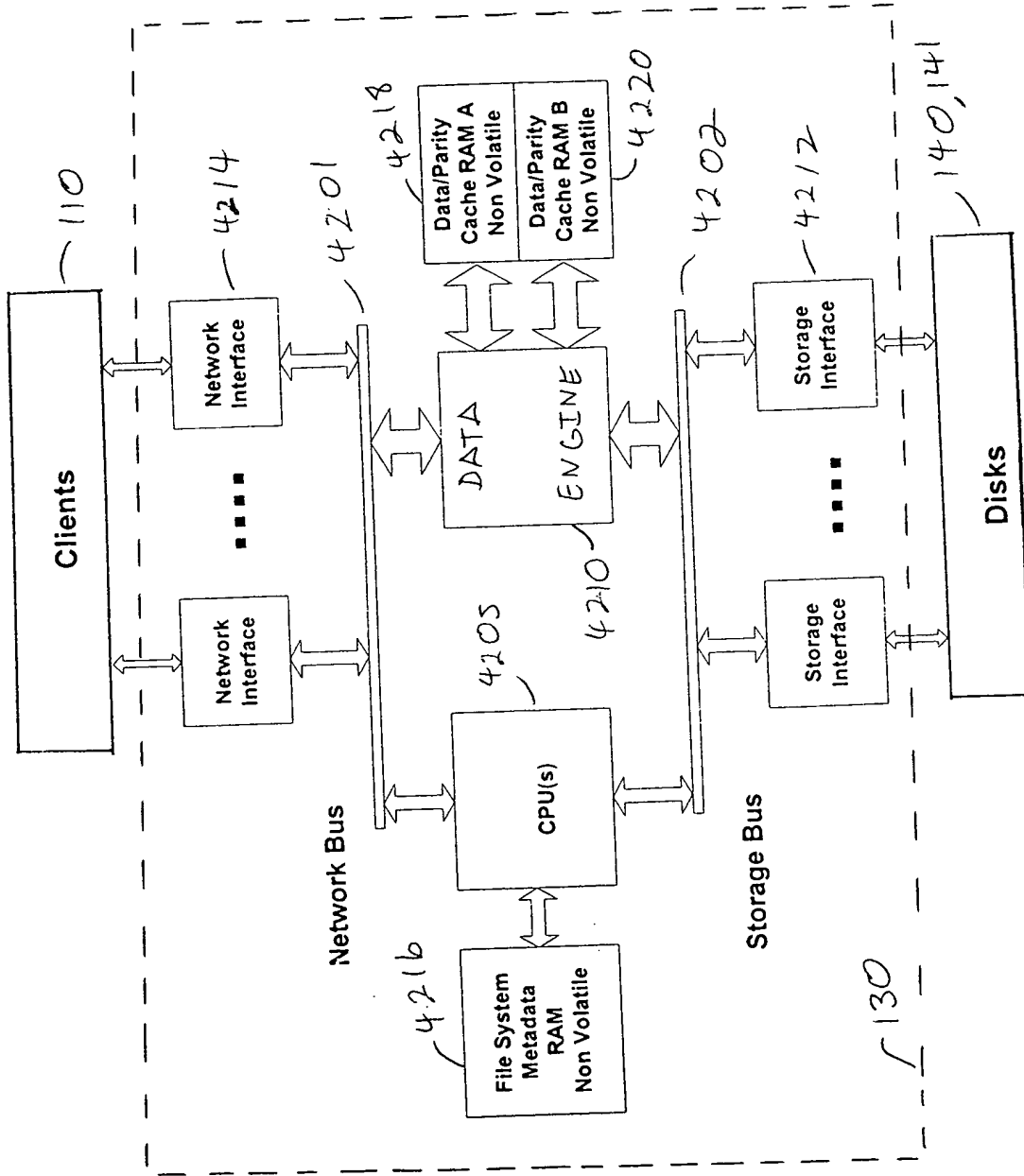


FIGURE 42

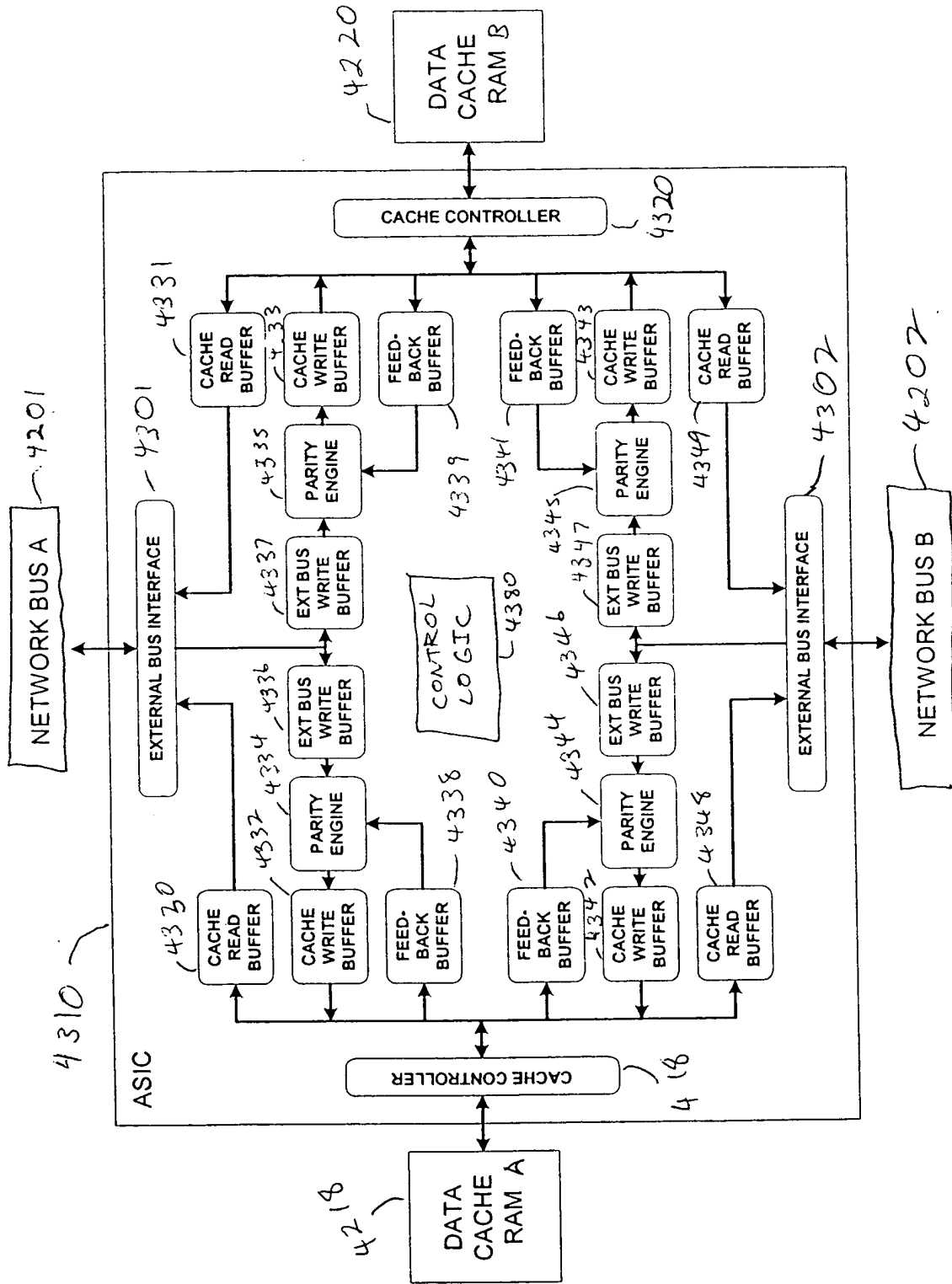


FIGURE 43

PCI map	Block Size	Opcode	Spare	Parity Index	Spare	RAM Adr
63----	62, 61-----	59, 58-----	56, 55-----	51, 50-----	35, 34, 32, 31-----	0

4400

FIGURE

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